JK STUDENT UPDATE

Previous Year Papers, Model Papers, PDF Notes

Guess Papers

9^{th}, 10^{th}, 11^{th}, 12^{th}, UG, PG Syllabus

DOWNLOAD HERE

JOIN OUR WHATSAPP GROUP

Click Here

JOIN OUR TELEGRAM GROUP

Click Here

ENVIRONMENTAL STUDIES

Effective from Academic Session 2016 and onwards

UNIVERSITY OF KASHMIR

COURSE MATERIAL

According to the new UGSCBCS Syllabus-

2016 Ist Year (Semester Ist and 2nd)

PRELIMINARY

Keeping in view the prevailing conditions in the valley and the huge loss to the academics of the students there-from, the Higher Education Department of J&K along-with the University of Kashmir has initiated the process of uploading instructional/study material in a bid to provide partial respite to the distressed undergraduate students of the valley. This move has been initiated with the view to compensate the academic loss by engaging the students through e-learning process.

The study/course material of environmental studies (Ability Enhancement Compulsory Course, AECC) based on CBCS 1st Year (Semester 1&2) for the academic session-2016 conforms to the guidelines set in the meeting held at A.S. College Srinagar Kashmir on 06-10-2016. Emphasis has been laid on the view that the entire syllabus gets covered, which will lay a foundation for the learners to enable them in learning the course.

As all the educational institutions including degree colleges across the Kashmir valley for the last more than three months are closed, so emphasis has been laid on providing the students with e-learning in full support to combat the loss created due to the unrest in the valley. In this back drop, e-lectures have been prepared to engage the students in e-learning process. Although the study material allows the learner to learn at his/her place but exploratory and hands-on activities, discussions, opinions and experiments can't be compensated by e-learning. This mode of learning can't be a substitute or alternative to class work.

For easy download of course material, it has been divided into two parts viz. Part-1 for Credits-I TO IV and Part-2 for Credit-II complete details.

Meanwhile the students are encouraged to seek further information from their teachers so that active participation is fostered.

DATED: 25/10/2016 (Srinagar Kmr)

Course Preparation Team

Credit-I:

Dr. Mubashir Jeelani (A/P)

Government Degree College Bemina Srinagar Kashmir-190018

Credit-II

Prof. Sumera Shafi (A/P)

SAM Degree College Budgam Kashmir-

Credit-III

Mr. Bilal Ahmad Lone (C/L)

Government Degree College Bemina Srinagar Kashmir-190018

Credit-IV

Mr. Sameer Ahmad Parsa (C/L)

Government Degree College Bemina Srinagar Kashmir-190018

Syllabus/Contents for BA/B.Sc./B.Com./B.Sc.IT/BBA/BCA/B.Tech./B.Pharma/BBA-MBA/OC & MIL

Ist Year (Semester Ist and 2nd)

Credit I: Understanding Environment

1.1 Environment: Concept and importance.
1.2 Components of Environment: Physical, Biological and Social.
1.3 Ecosystem Definition, Structure and Function
    1.3.1 Producers, consumers and decomposers
    1.3.2 Food chains, food webs and ecological pyramids
    1.3.3 Energy flow in an ecosystem
1.4 Ecosystem services: Ecological, economical, social, aesthetic and Informational value.

Credit II: Natural Resources

2.1 Land resources: Global land use patterns, concept of land degradation and Desertification.
2.2 Forest resources: Use and consequences of over-exploitation.
2.3 Water resources: Use and consequences of over-utilization,
concept of water harvesting and watershed management, water conflicts.
2.4 Energy resources: Renewable and non renewable resources, growing energy needs and alternate energy sources

Credit III: Biodiversity and its Conservation

3.1. Biodiversity: definition, levels and values (commercial, ecological, social and aesthetic)
3.2 Threats to the biodiversity: Habitat loss, poaching of wildlife, man-wildlife Conflicts.
3.3 Concept of endemism and hot spots of biodiversity.
3.4 Conservation of biodiversity: In-situ and Ex-situ concepts.

Credit IV: Environmental Issues, policies and practices

4.1 Causes, effects and control measures of: Air, water, Soil, Noise and solid waste pollution
4.2 Concept of natural disasters and Global environmental issues: Increase in green house gases,
Climate change, Acid rain and stratospheric ozone layer depletion.
4.3 Salient features of:
4.3.1 Water (Prevention and control of pollution) Act, 1974.
4.3.2 Air (Prevention and control of pollution) Act, 1981.
4.3.3 Environmental Protection Act, 1986.
4.4 Environmental education, Environmental Movements (Chipko, Silent valley) and Environmental Ethics

CREDIT I: UNDERSTANDING ENVIRONMENT

After studying credit-I, you will be able to

1. Explain the concept of environment; list natural and manmade environments; importance of maintaining balanced ecosystems.

2. Recognise the components of ecosystems; by giving examples of pond and forest ecosystems.

3. Idea of food chain and food web; trophic levels.

4. Explain energy flow in an ecosystem; producers, consumers and decomposers.

5. Benefits obtained from the ecosystems.

1.1: ENVIRONMENT: CONCEPT AND IMPORTANCE

The concept of environmental studies gives us the understanding of the interrelationships between living components like plants, animals, microbes and non-living components like air, water, soil, temperature etc.

It explains how we are able to sustain life. Anything effecting the environment good or bad will involve us and the extent we are affected depends upon the environment. By concerning about the environment will let us know about the air, water, soil, plants, animals, microbes, land etc. For example what kind of agriculture farming we should follow? Similarly it makes us understand the ability of plants and animals to sustain and adapt. It also makes us understand how man is able to contribute to too many environmental problems as he modifies it as per his wishes and greediness. The concept of environment studies provides us with the ways and means to solve these problems through environmental management. The concept of the environmental studies gives us the understanding of the interrelationships between plants, animals, microbes (biotic) and air, water, soil, temperature (abiotic) components.

The main outcome of the concept of environmental studies is as under:

1. It gives us the understanding of the multidisciplinary nature of the environment

2. It introduces us to various issues associated with our surroundings. Its studies provide us the understanding of pollution of water, air, soil etc.

3. It provides us the fundamental knowledge of environment (surroundings).

4. The concept also empowers us with the methods of monitoring, measuring and assessing the environmental effects (impacts).

5. It enables us to provide managerial practices.

Objectives: After studying students will be able to

1. Define the term environment.

2. List various factors based on the concept of studies of environment.

3. Awareness among human beings about their environment.

IMPORTANCE

The studies on Environment today has become more important because the changes with respect to climate, forests, pollution, depletion of ozone layer, biodiversity loss, global warming, reduced energy resources, solid waste generation are becoming rapid and detrimental. To defeat the detrimental effects, the studies of environment becomes important in bringing sustained life support systems, hygienic living conditions, clean drinking water, town planning, land use pattern, location of industries etc.

Today the interaction between nature and the society is so extensive that environmental question has assumed all proportions affecting all humanity. The destruction and pollution has threatened the human life, health and livelihood. We are facing with poverty, hunger, ill-health, illiteracy and the continuous deterioration of the ecosystems on which we depend. With the result there has been thrust on the protection of environment not only in our country but throughout the world. If the quality of the life is to be assured to the present and the future generations and to be saved from the catastrophe, the environment has to be protected. It is a basic right of all to live in a healthy environment.

In addition our country needs development and that too fast. But that can't be done at the cost of our environment. We can't endanger our life as well as the life of future generations. We have to think sustainably. Today we need **Development, Environment and Peace** which are interdependent and indivisible. The present century particularly the later half has seen a lot of growth and economic development. The methods of economic development which mankind has followed have created environmental problems. The industrialization, urbanization and erosion of biodiversity have affected the natural environment adversely.

Objectives: After studying students will be able to

1. List and describe various components responsible for destruction of environment.

2. Why should we be concerned about the environment?

1.2: COMPONENTS OF ENVIRONMENT

Environment is the complete range of external conditions under which an organism lives including physical, chemical, biological and social.

PHYSICAL COMPONENTS (ABIOTIC)*:* It includes purely physical factors such as temperature, light, humidity, climate, pressure and thickness of air, density and mass of air, scattering, absorption, emission, air pollution, fog, smog, mist, wind, ultra violet radiations.

CHEMICAL COMPONENTS (ABIOTIC): All the physical components (atmosphere, hydrosphere, lithosphere and biosphere) are constituted mainly because of the inorganic and the organic substances present in each component.

BIOLOGICAL COMPONENTS (BIOTIC)*:* This includes the living components of the environment and is made up of many different populations which are interdependent upon each other in the environment.

SOCIAL COMPONENTS: This component is mostly referred to as social framework in which people live together. They have culture, heritage, religion, economy, class, societies, history, moral, and politics that affect the nature of an individual, population or community of human beings.

Objectives: After studying students will be able to

List and describe various components of environment.

1.3 ECOSYSTEM DEFINITION, STRUCTURE AND FUNCTION:

There are various notable living and non-living items at any visiting place in the environment. These living and non-living items follow the order of arrangement (structure) and performance (functioning). For instance the sun rises in the east every day and sets in the west. The plants trap the solar energy, grow and feed other organisms like animals and humans. The energy comes from the sun, passes through the plants and gets passed on to the animals through the process of eating. Then upon death, these plants and animals are decomposed by the bacteria. **In this system every plant and animal has a position of receiving or transmitting the material (energy and nutrients). The position of these plants and animals in the environment forms the structure.** There is nonstop release and recycling of gases between the spheres like air, water and soil this system. The plants and animals are endlessly under the influence of various non-living conditions. Based on the various materials available to us in our environment (surroundings) as biotic (living) and abiotic (non-living) components, and the influence upon each other, **the British ecologist A.G.Tansley in 1935 gave the concept of ecosystem and defined it as "the system resulting from the integration of all the living and non-living things of the environment".** We also know about the linkages between biotic and abiotic items. We have observed the interdependency of one organism on another. The sun is the ultimate source of energy; the plants utilize this energy to manufacture their own food. In turn the animals become dependent on the plants for food. There is continuous cycling and recycling of nutrients like N, P, K, C, S).

1.3.1. STRUCTURE OF AN ECOSYSTEM

The living and non-living items at any place in the environment or in an ecosystem follow the order of arrangement called as structure. Based on the structure of an ecosystem Odum in 1971 divided ecosystem into two major components:

A. BIOTIC COMPONENTS includes the living components of the environment and is made up of many different populations which are interdependent upon each other in the environment. These include:

(a) Producers or Autotrophs: The word autotrophs comes from the two Greek words "auto" means "self" and "trophos" means "feeder". These include the green plants which manufacture their own food through the process of photosynthesis. These are also called producers. The reaction involved during photosynthesis is as follows:

$$6CO_2 + 6H_2O \xrightarrow{\text{Solar energy}} C_6H_{12}O_6 + 6O_2$$

(b) Consumers or Heterotrophs: The word heterotrophs comes from the two Greek words "hetero" means "other" and "trophos" means "feeder". These include those organisms which depend on others for their food and are also called consumers. Consumers are further divided into three groups:

(i) Herbivores: Those animals which eat only plants are called herbivores. Some of the examples of herbivores are cow, buffalo, sheep, goat, horse, deer, ox etc. The animals which get their food directly from producers (i.e. plants) are also called primary consumers.

(ii) Carnivores: Those animals which eat meat (or flesh) of other animals are called carnivores. Some of the examples of carnivores are lion, leopard, wolf etc. The small carnivores which feed on primary consumers (herbivores) are called secondary consumers e.g. fox, wild cats, snakes etc. The large carnivore (top carnivores) which feed upon the small carnivore (secondary consumer) are called tertiary consumers e.g. wolf eating upon fox.

(iii) Omnivores: Those animals which eat both plants and animals are called omnivores. In other words the omnivore eat plant as food and as well as flesh or meat of other animals. Some of the examples of omnivores are man, bear, crow etc.

(c) Decomposers or Saprotrophs: The word saprotrophs comes from the two Greek words "sapro" means "rotten" and "trophos" means "feeder". These are also called decomposers or reducers. The micro organisms which breakdown the complex organic compounds present in dead organisms like dead plants and animals and their products like urine faeces etc. into simpler substances are called decomposers. It is only due to the presence of decomposers that the various nutrients which were initially taken by the plants from the soil and air are returned to the soil and air after the death of plants and animals. Thus the decomposers help in nutrient cycling in an ecosystem.

B. ABIOTIC COMPONENTS: These are the non living components and include:

(a) Physical factors such as air, water, soil, temperature, climate, weather, rain, humidity, light etc.

(b) Chemical factors constituting the inorganic mainly minerals in the soil and atmosphere (potassium, sodium, phosphorus, and nitrogen), gases (carbon dioxide and oxygen) and the organic substances (carbohydrates, lipids, proteins and humus) found in soil as a result of activities of living organisms. This component can directly or indirectly alter the physical, thermal, biological or radioactive properties of any part of the environment in such a way as to create a potential hazard to the health, safety or welfare of any living species. Air, water and land are the basic amenities of life. Over population and rapid utilization of these has given rise to pollutants leading to health hazards.

1.3.2. FUNCTION OF AN ECOSYSTEM

The functioning of an ecosystem has non-living components like air, water, soil, inorganic nutrients and the living components include producer, consumer and decomposer organisms. All these components make the ecosystem functional e.g. Producers (plants) trap the solar energy and provides the basic food or energy to all other organisms in an ecosystem. Then consumers (animals) derive their energy from producers (eating). When the producers and consumers die, the decomposers act on their dead bodies to return the various elements back to the nutrient pool (soil, water and air). **Thus, the functioning of an ecosystem involves transfer of energy and matter from one tropic level to another. The functioning of an ecosystem is described as food chain, food web, ecological pyramids and energy flow in an ecosystem given below.**

Objectives: After studying students will be able to

Describe the components of an ecosystem and explain their functioning.

FOOD CHAINS

When there is transfer of energy from the sun to the producers i.e. green plants, then to the next series of organisms (consumers) in a linear fashion referred in the given table supported by non-living components is known as food chain.

Abiotic	Biotic		LEVEL-I		LEVEL-II		LEVEL-III
Sun/CO_2/H_2O	(Producer)	⇒	Consumer	⇒	Consumer	⇒	Consumer
Sun/CO_2/H_2O	Green Plants/vegetables	⇒	Sheep/Goat/Human	⇒	Wolf/Human	⇒	Tiger
Sun/CO_2/H_2O	Plants	⇒	Mouse	⇒	Snake	⇒	Bird (Hawk)

Sun/CO_2 /H_2O	**Phytoplankton**	⇒	**Zooplankton/Insects**	⇒	**Fish**	⇒	**Human**

TYPES OF FOOD CHAINS:

I. Grazing food chain (plants→herbivore→carnivores)

i. Predatory food chain (green plants →deer →leopard)

ii. Parasitic food chain (parasite →intermediate host →host)

II. Detritus food chain (dead organic matter→microbes→detrivores→predators)

I. Grazing food chain: A food chain in which the primary consumer feeds on living plants is called grazing food chain. The grazing food chain starts from the living green plants, goes to grazing herbivores and on to predators (animal eaters). Ecosystems with such type of food chain are directly dependent on an influx of solar radiation.

i. Predatory food chain: This food chain involves killing of one animal by another angrily. Here the killed animal is called the prey and the animal that kills is called predator. For example the deer is killed by leopard. Here the prey is deer and the predator is leopard.

ii. Parasitic food chain: In environment the plants and animals are infected by various kinds of parasites. These parasites gets entry into the intermediate host and then to the host. For example the parasite got entered into the intermediate host (pig), then moved to host (human) and again entered into the environment. From the environment they again enter intermediate host and keep on cycling.

II. Detritus food chain: Upon the death of plants and animals, an ample amount of dead organic matter is accumulated which is called as detritus. This detritus becomes a source of energy for the organisms which are known as detritivores and the eating and being eaten pattern by these organisms is called as detritus food chain. The various organisms that are involved in this chain are algae, bacteria, fungi, protozoa, insects, mites, crustacean, centipedes, mollusks etc.

Objectives: After studying students will be able to

Explain food chain and the existing relationship between biotic and abiotic components in the ecosystems.

FOOD WEB

The food web is a representation of food eating habits of several organisms inter-connected and interlocked in an ecosystem. The food web involves several food chains. It is a system of interlocking and mutually dependent food chains. Under natural conditions the pattern of linear food chains almost not occurs and these remain interconnected

with each other through different kinds of organisms at different trophic levels. Thus, food chains through interconnections with each other form an interlocking system, which is referred to as food web. It can also be defined as who eats whom.

i. Linear food chain: A linear food chain is a network of interconnected organisms starting from the producers such as grasses or trees and ending at the apex (Predator/Consumer) like eagle etc. However, this linear food chain is also supported by the abiotic factors like sun and nutrients and biotic components like earthworms; fungi and bacteria (Detritivores).

Example: Grass, grasshopper, frogs, snake, eagle.

ii. Interlocked food chains: If there are more alternatives then more will be the interlocking pattern. Example is grass, grasshopper, lizard, hawk, snake, rabbit, mouse, and snake. The organisms involved here are interlocked at different points.

Objectives: After studying students will be able to

Explain the difference between food chain and the food web.

ECOLOGICAL PYRAMIDS (BIOTIC PYRAMIDS)

An ecological pyramid also known as trophic pyramid, Eltonian pyramid, energy pyramid, or food pyramid is a representation of showing a relationship between various organisms in terms of their numbers, biomass and energy. It was a British Ecologists Charles Elton who with the help of mathematical shapes devised a means of showing the relationship between various organisms. Today the ecological pyramids are commonly known as Eltonian pyramids in his honour. Three types of pyramids i.e. number, biomass and energy are given below.

1) **Pyramid of numbers**:

Pyramid of number is the numbers of individual organisms occupying an area in relation to food eating and being eaten pattern depicted in mathematical shapes.

In terrestrial ecosystems (grassland) the pyramid of numbers shows that the producers (grasses) are maximum in number. This number decreases towards the apex, thus the pyramid is upright. In forest ecosystem pyramid of number is somewhat different in shape. Here the producers are mainly large sized trees and they are lesser in number and they form the base of the pyramid. The primary consumer level i.e. herbivores i.e. fruit eating birds, etc. are more in number than the producers and then there is a successive decrease in secondary consumers like deer. Thus making the pyramid again upright.

In aquatic ecosystems (Pond) shows producers (phytoplankton) at the base are maximum in number. The number decreases further in zooplankton which feed on phytoplankton and then number of fishes at the apex also decrease which feed on zooplankton. Thus the pyramid of number in aquatic ecosystem is also upright.

In a parasitic food chain the pyramids are always inverted. Here a reverse trend is witnessed from producers towards the consumers i.e. the number of organisms shows gradual increase instead of decrease giving the pyramid an inverted shape.

2) **Pyramid of biomass**:

Pyramid of biomass is the total amount of dry weight of individual organisms occupying an area in relation to food eating and being eaten pattern depicted in mathematical shapes. The pyramid of biomass is of different shapes in different type of ecosystems. In the grassland ecosystem there is generally a gradual decrease in biomass of organisms at successive levels from producers to top carnivores, so pyramid is upright. The pyramid of biomass in a pond ecosystem the producers are small organisms with least biomass and this value gradually shows an increase towards apex of pyramid, thus making it inverted.

3) Pyramid of energy:

Pyramid of energy is the rate of energy flow or productivity at successive trophic levels of individual organisms occupying an area in relation to food eating and being eaten pattern depicted in mathematical shapes. In contrast with number and biomass pyramids, the energy pyramid is a picture of the rates of passage of food mass through the food chain. Its shape is not affected by variation in size and metabolic rate of individuals. If the sources of energy are considered it must always be upright in shape because it is governed by second law of thermodynamics.

Objectives: After studying students will be able to

Describe pyramids based on account of count of producers and consumers, accumulated energy and interconnected feeding relationship in an ecosystem.

1.3.3. ENERGY FLOW IN AN ECOSYSTEM

Energy flow also called as calorific flow can be defined as that energy which gets transferred from one organism to another in an ecosystem. The producers (green plants) obtain the energy from the sun for manufacturing their own food through the process of photosynthesis. These primary producers (photoautotroph's) like green plants are the basic key elements for functioning of the energy flow in any ecosystem. Then the energy gets transferred to other trophic levels through the pattern of eating which is called as food chain. The energy flow is determined by two basic laws of

thermodynamics i.e **First law of thermodynamics** which states that energy is neither created nor destroyed, but can be transferred from one component to another and **Second law of thermodynamics** which states that every energy transformation involves degradation or dissipation of energy from a concentrated to a dispersed form due to metabolic functions, so that a small part of energy is stored in the biomass.

So energy flow of an ecosystem is characterized by:

a) Decrease in useful energy.
b) Unidirectional flow of energy.
c) Return of radiant energy of sun to non living system as heat.

Objectives: After studying students will be able to

Explain that the flow of energy is the basis of sustenance of any ecosystem?

1.4. ECOSYSTEM SERVICES: ECOLOGICAL, ECONOMIC, SOCIAL, AESTHETIC AND INFORMATIONAL VALUE

The benefits obtained from ecosystems are called as ecosystem services. The benefits arising from the ecological functions of healthy ecosystems are provided by soil, water, air and land to the human beings and other living beings which include plants and animals. Thus all biotic (living) and Abiotic (non-living) components of the ecosystem are included in the list of ecosystem services.

ECOLOGICAL VALUE

Healthy ecosystems are vital to life. They regulate many of the chemical and climatic systems that make available clean air and water and plentiful oxygen. Forests, for example, regulate the amount of carbon dioxide in the air, produce oxygen as a byproduct of photosynthesis (the process by which plants use sunlight to create energy), and control rainfall and soil erosion. These forests also provide humus to the soil through leaf litter and add nutrient strength to the soil. One of the strengths of our agriculture is the soil nutrients. These nutrients in the soil are being made available to the plants through biogeochemical cycles. These cycles are driven by soil microbes. A gram of fertile agricultural soil contains 2.5 billion bacteria, 4.0 lacs fungi, 50,000 algae and 30,000 protozoa. All these have their role to play in the soil and its fertility and they interact with each other. These micro organisms are also helpful in decreasing the toxicity of the soil which comes through the waste products. There is an array of other ecosystem services, a few are

1. Water purification system through natural systems

2. Role of bees in pollination

3. Watershed management

4. Afforestation

ECONOMIC VALUE

A large number of products are derived from air, water, and soil and are sold and bought in the market. These derived products have economic value in the market. The forest produce timber, gum, resins, oils, waxes, dyes and rubber which are sold and bought are of immense commercial value. The much of energy needs of the rural masses are still being met by forests. Well maintained trees and shrubs can increase property value by up to 14%. Trees properly placed around buildings can reduce air conditioning needs by 30%. A mature tree more than 50 yrs removes almost 70 times more pollution than a newly planted tree. A healthy tree can have a value of up to $10,0000 for its unknown services. The shade and wind buffering provided by trees reduces annual heating and cooling costs by 2.1 billion dollars. One tree can absorb as much carbon in a year as a car produces while driving 26,000 miles. Over the course of its life, a single tree can absorb one ton of carbon dioxide.

SOCIAL VALUE

An important place of honor has been given to the plants and animals in the galaxy of Hindu gods and their associates. There are animal gods like hanuman (Monkey), Ganapati (mice), Lord Vishnu sleeps on the snake, rides on the Garuda, while the god Ishwara and his sons Ganapathy and Subramanayam have the bull, mouse and the peacock as their vahans (ride) and goddess Durga has selected the tiger as her animal to ride. The early Indus civilization shows the use of animal symbols in their seals. Their mythology and literature are full of accounts of these animals.

AESTHETIC VALUE

The ornamental plants are still an attractive commodity or art of beauty in our drawing rooms, balconies, pavements, lawns and gardens etc. The unusual and interesting flora (Plants) and fauna (animals) still attracts lot of tourists especially when combined with scenic landscapes. The wildlife gives recreation to people of all walks of life. Bird watching is still a very popular pastime and profession among many people. The aesthetic value of the biodiversity also gives us some sort of feeling the pride. The Kashmir Stag is pride of the people of the state. Similarly the national animal tiger represents the country India.

INFORMATIONAL VALUE

Information literally means getting knowledge about someone or something based on facts while as the value measures the worth or usefulness of something. **In an ecosystem a set of biotic and abiotic factors work together with each other in an environment and they exchange energy with each other and there is cycling of nutrients etc. Informational value thus studies ecosystems with details on the information of the various biotic and abiotic factors about their ability to sustain. It also envisages to know the direct and indirect benefits of the ecosystems.** The ecosystems have value on the fact that it flourishes life on the earth. Besides it provides services to satisfy the

needs of the human beings. The following points can be useful in understanding the informational value of an ecosystem and can be elaborated further.

1. Role of forests in maintaining the environment and the value of oxygen provided by the forests.

2. The source of earning and economic gains derived out of land or soil.

3. The value of water when we have to purchase bottled water from the market.

4. The value of oxygen present in the atmosphere and the value we pay in purchasing oxygen cylinder for the purpose of medical treatment.

Objectives: After studying students will be able to

Elucidate the effects of exploitation of living resources of the earth and their value and the need to conserve them.

TERMS TO REMEMBER	
Environment	The air, water and land in / on which people, animals and plants live.
Organism	A single living plant, animal, virus etc. bacteria is a single celled organism.
Abiotic	Non-living parts like air, water, soil, sun
Biotic	Living things like plants, animals, bacteria , virus etc.
Factors	Living or non-living that affects any organism. For example too much hot or cold weather outside makes us uncomfortable. The pool of dirty water will invite the mosquito larvae which will make us ill.
Health	The condition of the body and the degree to which it is free from illness. For example the presence of pollutants in the air in New Delhi is causing health problems like asthma and ENT infections.
Scope of Environmental Sciences as a subject	The scope of the subject of environment is that it has created awareness among the people of their surroundings and has allowed them to know about the ways to protect it. It also tells us about the damages caused by humans to the environment. It gives us the idea of combating the problems and issues of the environment. It is the scope of the environment subject that today man has felt need to keep the temperature rise below 2^{0}C. It has also enabled the human beings to change theoretical knowledge into practical.
Components	The component word here signifies the living and non-living items important for the formation of environment.
Trophic level	Any stage of organisms that occupy the same position in the food chain as primary consumers, secondary consumers and so on is known as trophic level.
Sustainable development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
Over-exploitation	Human beings take too many products from their environment. These are either used as food or for other purposes. When the rate of harvest is more than its formation, it is called as over-exploitation. The best example today is the over-exploitation of the forests of J&K. The oil and gas (fossil fuel) is also being extracted at a faster rate.

Ecological balance	The ecological balance is the harmonious equilibrium between the organisms and their environment for their coexistence.

REVISION:

SELF ASSESSMENT TEST:

NATURAL RESOURCES

SUBMITTED BY:-Department of Environmental Science
Sheikh ul Alam Memorial Degree College, Budgam.

Resource:-A resource is anything which can be transformed in a way that it becomes more valuable and useful to meet the needs and desires of humans. The resource that is directly available for use from nature is called a natural resource, which includes fresh air, fresh water in lakes and rivers, soil, land, forest, grasslands, biodiversity, fisheries, ecosystems, minerals, salts, fossil fuels etc. In other words, natural resources are the goods and services supplied by our environment.

Type of Resources: Natural resources can be classified in different ways as follows:-

1. Based on their utility, natural resources can be classified as source of food, raw materials, energy etc.
2. Based on their origin, they are classified as biotic (living) or abiotic (non-living) resources. Biotic resources include all living organisms which includes plants, animals and micro-organisms. Abiotic resources include air, water, land, minerals etc.
3. Based on their quantity in nature and extent of continuous availability, they are classified into two categories:

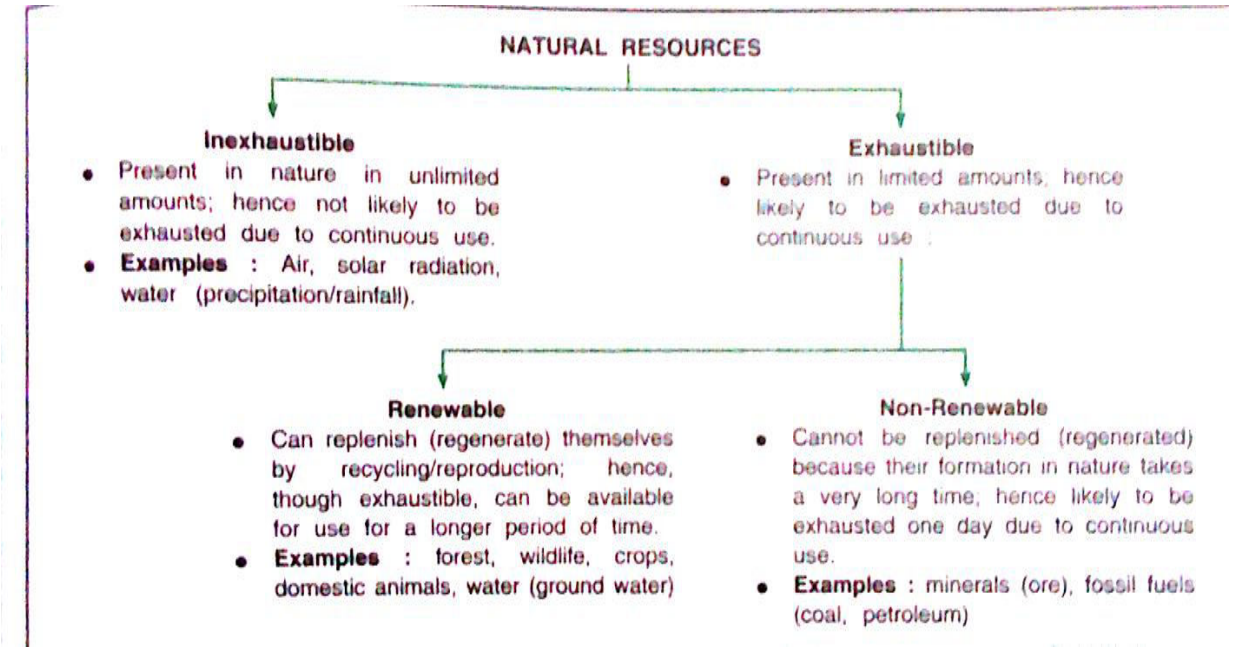
a. Inexhaustible resources: These are the resources which occur in unlimited quantites in nature and are not likely to be exhausted soon by human use and thus would last for fairly a longer period. These include air, water, sun.

b. Exhaustible resource: These are the resources which occur in limited amount in nature and therefore, likely to become exhausted one day due to continuous use. These include minerals, fossil fuels, forests, wildlife etc. These exhaustible resources are of two types: i)renewable and ii)non- renewable resources.

(i) Renewable resources:-Although exhaustible, these can be renewed(regenerated) simultaneously along with their exploitation, and hence are always available for longer periods. They can maintain themselves by natural recycling and reproduction or can be replenished if managed wisely. These include forests, crops, animals etc. These resources too may get

exhausted if not managed properly. For example, a species may get extinct by its over exploitation.

(ii)Non-renewable resources:-These cannot be recycled or replenished and hence, they get exhausted due to unlimited continuous use. They include mineral ores, coal petroleum etc. Formation of such resources takes several thousand of years, so once they are used in unlimited way they cannot be replaced easily.



Land or Soil resources

The coverage of Earth's surface with soil varies from place to place. Tropical forests have thin soils that are poor in nutrients, while grasslands in temperate regions have soils that are rich and well able to support crops. There are several different classes of soil depending on how the soil is formed and where it is located. An understanding of which class of soil is found in a particular location is an important foundation to obtaining successful crop yields.

Soil resources need conserving as much as water resources do. Erosion is the key process by which soil is created from rock and destroyed. Wind and rain are the main factors that cause erosion of soil from agricultural areas, possibly converting them into new desert. Some modern agricultural practices leave soil exposed to the elements and thereby risk loss of long-term productivity because of soil erosion.

Soil is as important as water as a resource. It provides nutrients and an anchor to the roots of plants and is therefore essential to their healthy growth and yield of food. It is a complex mixture of organic and mineral content which is constantly being formed by the weathering of rocks. Soil has a layered structure, with the topsoil being around 4 inch (10 cm) deep and rich in organic material. Then there is a layer between topsoil and subsoil through which dissolved or suspended matter moves. Below this is the subsoil, where humic compounds, clay, iron, and aluminum may accumulate after leaching from the upper layers. Finally there is the actual bedrock, which is the source of the soil through weathering processes. Soil is also classified according to the size of the particles it contains. A soil with a lot of clay has fine particles, while one with a lot of gravel is coarser. A knowledge of soil resources, which is concerned with the type and distribution of soils around the world, is an important factor in global food supply. Soils are classified according to their type and composition. The best soils for farming are known as mollisols and alfisols, both of which are rich in organic matter. Both of them form wherever rainfall and precipitation are moderate. Spodosol is another class of soil; it is formed under pine forests, where the acidic needle litter will form a characteristic white and ashy looking middle layer. Hot and rainy environments have quite different soils. Oxisols and ultisols are the two classes found in these locations. They are severely depleted of nutrients and they are red in color because they contain a lot of iron-rich minerals. In arid environments, aridosols are the predominant soil class. These are characterized by their low organic content and the presence of

accumulated salt. Some classes of soil are defined by how they are formed. Andisol comes from volcanic material and vertisol from clay-rich material, for example.

Soil is a renewable resource. It is constantly being formed and destroyed, mainly by erosion processes. Although erosion can spread rich soils by wearing down mountains, it can also lead to removal of top soils from agricultural areas. When erosion removes too much soil, the farmer will need to apply more fertilizer, which can cause pollution problems through runoff. Annual soil loss from agricultural lands amounts to as much as 25 billion metric tons, although this only leads to a loss of about 1% in crop production, because of compensating applications of water and fertilizer.

Wind and water are the main agents of soil erosion. Their impact is accelerated by removal of vegetation, as in deforestation. Soil erosion is not always compensated by the farmer and may therefore lead to desertification, in which productive agricultural land is gradually converted into desert. Intensive farming makes a large contribution to soil erosion because practices like sowing row crops leaves soil exposed to wind and rain.

Land Use Pattern

Land use is the human use of territory for economic, residential, recreational, conservational, and governmental purposes. The concept of land use pattern is closely intertwined with human community development. Patterns of human development and land use have shaped the environment locally and globally since prehistoric times. Current development patterns, together with features of the natural environment and the consequences of past development activities, determine future development opportunities, and also the need for restoration or enhancement of environmental resources. The balance of so-called developed and undeveloped land is central to the concerns about the environment in regions heavily impacted by human populations such as major metropolitan areas and adjacent rural areas. Many of the major controversies over land use have arisen in these areas where expanding human communities impinge upon wild and less developed areas. Increasingly in North America, Western Europe, Japan, and other highly industrialized parts of the world, government and non-governmental organizations (NGOs) are planning land use in these urban-rural “interface” zones. The main objective of these plans is to identify and manage the growth of developed areas based on current land uses, development activities, population density, impervious surfaces that cause water runoff, and existing community infrastructure.

Considerations of land use pattern and development planning are most prominent in economically advanced countries. In less industrially developed countries, in spite of what is often a dire need for land use management, land use and development planning is limited or non-existent. The ways in which municipalities, states, and nations plan the physical arrangement or land use of our communities is critical to sustainability. These land use patterns, which are shared by cities across, worldwide, have given rise to complex problems created by urban sprawl faced by all growing traffic congestion and lengthening commute times, air pollution, wasteful energy consumption and greater reliance on petroleum, elimination of open space and wildlife habitat, unfair distribution of economic assets, and the loss of community consciousness. Increasing the sustainability of communities will require a shift from poorly managed sprawl to land use planning that can build and keep up efficient infrastructure, encourage close-knit neighborhoods and community consciousness, and preserve the environment.

Land use in India

Land Cover	Forest	Grassland	Cropland	Wetland	Sub urban Construction
Land Use	Deforestation/ logging	Grazing/ Ranching	Cultivation	Wildlife Reserve	City/Urban areas
Bio-Physical Variables	Slash-Burn Agriculture	Planting and Fertilizing	Intercropping	Biodiversity	Drains/Paved Surfaces

Land use Pattern in India

Cultivated Area	Pasture land	Forestland	Wasteland
60%	5%	33%	30%

Concept of Land Degradation

Soil is under increasing threat from a wide range of human activities that are undermining its long-term availability and viability. One third of the world's agricultural soils, or approximately 2 billion hectares of land are affected by soil degradation. Water and wind erosion account for most of the observed damage, while other forms such as physical and chemical degradation are responsible for the rest. Appropriate soil and water conservation strategies are needed to prevent and combat the effects of soil degradation in the field and at the planning level. Soil degradation is ''a process that describes human induced phenomena which lower the current and/or future

capacity of the soil to support human life.'' In a general sense, soil degradation could be described as the deterioration of soil quality, or in other words: the partial or entire loss of one or more functions of the soil. Quality should be assessed in terms of the different potential functions of the soil.

Land degradation is the reduction in the capability of the land to produce benefits from a particular land use under a specified form of land management. Seven main groups of land-degradation processes are normally distinguished: (1) mass movement (such as debris flows and avalanches), (2) water erosion (sheet, rill, gully erosion), (3) wind erosion, (4) excess of salts (salinization, sodification), (5) chemical degradation (acidification, contamination, toxicity), (6) physical degradation (crusting, compaction, oxidation), and (7) biological degradation (loss of soil biodiversity). An important aspect of many soil and land degradation processes are the so called off-site effects; for example, dust storms or eroded sediment cause problems such as damage by mudflows, siltation of dams, or pollution of drinking water in downwind or downstream areas.

Factors and Processes Affecting Degradation of Soils

Various types of human activities may lead to soil degradation. Although some degradation processes may also occur naturally, many degradation types are the result of human disturbance of either a natural or anthropogenic state of equilibrium. Some of these are:

Agricultural causes: Defined as the improper management of cultivated arable land. It includes a wide variety of practices, such as insufficient or excessive use of fertilizers, shortening of the fallow period in shifting cultivation, use of poor quality irrigation water, absence or bad maintenance of erosion-control measures, improper use of heavy machinery, etc. Degradation types commonly linked to this causative factor are erosion (water or wind), compaction, loss of nutrients, salinization, and pollution (by pesticides or fertilizers).

Deforestation or removal of natural vegetation: Defined as the near complete removal of natural vegetation (usually primary or secondary forest) from large stretches of land, for example by converting forest into agricultural land (hence sometimes followed by agricultural mismanagement), large-scale commercial forestry, road construction, urban development, etc. Deforestation often causes erosion and loss of nutrients.

Overexploitation of vegetation for domestic use: Contrary to 'deforestation or removal of natural vegetation,' this causative factor does not necessarily involve the (near) complete

removal of the 'natural' vegetation, but rather a degeneration of the remaining vegetation, thus offering insufficient protection against erosion. It includes activities such as excessive gathering of fuel wood, fodder, (local) timber, etc.

Overexploitation of natural water resources: This leads to water shortages for the natural ecosystem and in the long term to the removal of the natural vegetation cover. The result is an increased vulnerability of the land for surface runoff, soil erosion, and soil surface crusting. As soon as the process of vegetation deterioration starts, it normally has a self-enhancing effect which is difficult to stop or to reverse.

Overgrazing: Besides actual overgrazing of the vegetation by livestock, other phenomena of excessive livestock amounts are also considered here, such as trampling. The effect of overgrazing usually is soil compaction and/or a decrease in plant cover, both of which may in turn give rise to water or wind erosion.

Industrial activities: All human activities of an industrial or bio-industrial nature are included: industries, power generation, infrastructure and urbanization, waste handling, traffic, etc. It is most often linked to pollution of different kinds (either point source or diffuse) and loss of productive function.

Types of Soil Degradation

The type of soil degradation refers to the nature of the degradation process. Soil particles may be displaced by the action of water or wind (erosion and sedimentation), which may cause damage to crops, infrastructure, buildings, and the environment in general. Erosion can be linear, i.e., concentrated along certain channels (rill or gully erosion and mass wasting such as landslides), sometimes creating very deep scars in the landscape. Less conspicuous, but often even more detrimental to crops is the gradual removal of the topsoil layer (sheet erosion). Off-site effects of erosion may consist of siltation of reservoirs and river beds and/or flooding, or dune formation and 'over blowing' in the case of wind erosion. Degradation in situ, i.e., without movement of soil particles, can be chemical (soil pollution by chemical wastes or excessive fertilization; fertility decline due to nutrients being removed by harvesting, erosion and leaching; salinization due to irrigation with saline groundwater and/or without proper drainage in semiarid and arid areas, acidification due to pH-lowering additions to the soil from fertilizers or from the atmosphere), or physical (compaction due to the use of heavy machinery; deteriorating soil

structure such as crusting of the soil surface; water logging due to increased water table or its opposite, aridification).

Desertification

When vegetation is lost from a dry land area, surface soil blows away leaving bare, dry, unprotected layers that harden and becomes less infertile. This type of land degradation is known as desertification. Up to 20% of the world's dry lands (excluding areas that are already deserts) have now undergone some degree of desertification with around one billion people at risk of its effects. The term does not refer to the expansion of existing desert. The two main causes of desertification are climate variation and human exploitation of vulnerable dry lands. Desertification has many adverse effects, both economic and ecological. Loss of crops and water supplies lead to hardship, famine, and disease, while habitat loss causes loss of biodiversity. The best way to combat desertification is to try to use dry lands in a more sustainable and appropriate manner, so that these fragile ecosystems are conserved.

Desertification is defined as the persistent degradation of land in arid, semi-arid, and dry sub humid areas, all of which have limited water supplies. Such dry lands are especially vulnerable to both climatic variation and human activity, which are the leading causes of desertification. Population growth and the resulting increased demand for food lead to cultivation of less than ideal land, such as the dry land areas. Meanwhile, although the relationships between global warming and desertification are complex increased temperature will, on the whole, encourage drought. Loss of vegetation is the key underlying cause of desertification. Plants hold moisture in the soil and provide a natural windbreak. Without them, the soil is blown away and becomes increasingly drier and unable to support plant life, including crops, forage for livestock, and wood. Drought tends to lead to vegetation loss and desertification, because the plants do not receive enough water. A switch from nomadic to sedentary, and increasingly intensive, farming tends to encourage overgrazing, which occurs whenever there are more livestock than the land can support without degradation. Deforestation, through logging activities or clearing land for cash crops or other export activities, also causes desertification through loss of trees. Inappropriate irrigation schemes may cause increased salinity of the soil, which also leads to extensive degradation. There are many underlying human factors underlying the causes of desertification. Increased populations will naturally put more pressure on dry lands to yield food, which can lead to overgrazing and overplanting. But under population can be a problem too, in

some areas. For instance, many hillside terraces in Yemen have become neglected and are at risk, because there are not enough people left to care for the land, following extensive migration to neighboring oil-rich countries. War or natural disaster can also deplete an area of those who might look after its land. Ignorance about how to look after dry lands to keep them fertile also plays a part in desertification.

Forest Resources

Forest Resources: Use, Over Exploitation, Causes and Effects!

The word 'forest' is derived from the Latin word 'foris' means 'outside' (may be the reference was to a village boundary or fence separating the village and the forest land).

A forest is a natural, self-sustaining biotic community with predominance of tree, shrubs and other woody vegetation, usually with a closed canopy and is an important renewable natural resource.

India is rich in forest resources with a great diversity of flora and fauna. Indian forests range from evergreen tropical rain forests (in north-eastern parts of the country, Western Ghats, and Andaman and Nicobar Islands) to dry alpine shrubs (in Himalayas) with a wide variety of other forest types between these two extremes.

Uses of Forest Resources:-

Forests are extremely useful for life on this planet. They benefit human beings directly as well as indirectly in a variety of ways

The direct benefits from forests are:

(a) Fuel Wood:

For the rural population wood is an important source of energy for cooking and for keeping warm.

(b) Timber:

The wood provided by forests can be used for making furniture, doors, windows, tool-handles, railway sleepers, matches, ploughs, bridges, boats, sports goods etc.

(c) Bamboos:

These are used for matting, flooring, baskets, ropes, rafts, cots etc.

(d) Food:

Forests provide a large number of products which find an important place in the diet of human beings. Fruits, leaves, roots and tubers of plants and meat of forest animals form the food of forest tribes.

(e) Shelter:

Forests provide a shelter to tribal people who depend on plants and animals in the forests for obtaining food, fodder, medicines etc. Mosses, ferns, insects, birds, reptiles, mammals and micro-organisms are also provided shelter by forests.

(f) Paper:

Wood and Bamboo pulp are used for manufacturing paper (Newsprint, stationery, packing paper, sanitary paper)

(g) Forest Products:

Tannins, gums, drugs, spices, insecticides, waxes, honey, horns, musk, ivory, hides etc. are all provided by the flora and fauna of forests.

(h)Tourism:-

Forests increase beauty of landscape and are opening new avenues for tourism called ecotourism, thereby attracting tourists. The tourists enjoy the cool and clean environment of the forests

(i)Employment opportunities:-

The forests are helpful in generating employment opportunities to the people.

The indirect benefits from forests are:

(a) Conservation of Soil:

Forests prevent soil erosion by binding the soil with the network of roots of the different plants and reduce the velocity of wind and rain — which are the chief agents causing erosion.

(b) Soil-improvement:

Forests help in reducing desertification and land degradation. The fertility of the soil increases due to the humus which is formed by the decay of forest litter.

(c) Reduction of Atmospheric Pollution:

By using up carbon dioxide and giving off oxygen during the process of photosynthesis, forests reduce pollution and purify the environment. Absorption of carbon dioxide by the forests also contributes towards decreasing greenhouse effect in the atmosphere.

(d) Control of Climate:

Transpiration of plants increases the atmospheric humidity which affects rainfall and cools the atmosphere.

(e) Control of Water flow:

In the forests, the thick layer of humus acts like a big sponge and soaks rain water preventing run-off, thereby preventing flash-floods. Humus prevents quick evaporation of water, thereby ensuring a perennial supply of water to streams, springs and wells.

(f)Minimize Natural Hazards:-

Natural hazards such as floods, droughts, landslides, storms etc occur largely due to depletion of forest cover. Forests contribute significantly towards minimizing these natural hazards. Thick forest cover binds the soil together, which prevents landslides and prevents fast flow of water thus helping in water retention in the soil, thereby preventing droughts. Forests also reduce the fury of storms thereby preventing a great amount of damage.

(g) Regulation of Hydrological cycle:-

Forests help in regulation of hydrological cycle. They help in cloud formations and contribute to rainfall by maintaining transpiration and evaporation processes.

(h) Provide Habitat:-

Forests provide habitat to wild animals and help in maintaining biodiversity. Forests contain the greater number of species compared to any other terrestrial ecosystems.

Over-exploitation of Forests:-

The forest cover in the country is decreasing every year. The forest cover of the country in the year 2003 was assessed as 20.64% and according to latest report of the Forest Survey of India, the actual forest cover of India is19.27% of the geographical area. The growing population and rapid industrialization and many related activities are responsible for forest area exploitation

Deforestation:

The term deforestation refers to the removal or reduction of forest cover. Deforestation is the permanent destruction of indigenous forests and woodlands. The destruction of forests due to unscrupulous and indiscriminate felling of trees has lead to an overall deterioration of our

environment and is posing a serious threat to the quality of "life in future. Trees are cut for many purposes; the important reasons responsible for destruction of forests are as under:

Causes of Deforestation:

(1) Population Explosion:

Population explosion poses a grave threat to the environment. Vast areas of forest land are cleared of trees to reclaim land for human settlements (factories, agriculture, housing, roads, railway tracks etc.) growth of population increases the demand for forest products like timber, firewood, paper and other valuable products of industrial importance, all necessitating felling of trees.

(2) Forest Fires:

Fires in the forests may be due to natural calamities or human activities:

(a) Smoldering of the humus and organic matter forming a thick cover over the forest floor (i.e. ground fires).

(b) Dried twigs and leaves may catch fire (i.e. surface fires).

(c) In densely populated forests, tree tops may catch fire by heat produced by constant rubbing against each other (i.e. crown fires).

(d) Human activities like clearing forest for habitation, agriculture, firewood, construction of roads, railway tracks and carelessness (throwing burning cigarette stubbs on dried foliage).

Fire destroys fully grown trees, results in killing and scorching of the seeds, humus, ground flora and animal life.

(3) Grazing Animals:

Trampling of the forest soil in the course of overgrazing by livestock has many reaching effects such as loss of porosity of soil, soil erosion and desertification of the previously fertile forest area.

(4) Pest Attack:

Forest pests like insects etc. destroy trees by eating up the leaves, boring into shoots and by spreading diseases.

(5)Expansion of cities:

Owing to the growing population, there is an ever- increasing demand for providing housing facilities. Large areas of forests are being cleared across the world in order to provide accommodation to more and more people.

(6)Development activities:

Development activities such as construction of dams, bridges, roads etc. have caused large scale cutting of trees.

(7)Mining:

Mining activities promote the deforestation process. Mining activities lead to irrepairable damage to the environment since they cause soil erosion and loss of biodiversity. Mining leaves the area unfit for any future use and destroys the scenic value of landscape.

(8)Shifting cultivation:

In shifting cultivation, plots of natural tree vegetation are burnt away and the cleared patches are used for two to three seasons for growing crops. After two to three harvests the nutrients are washed out of soil by the rain. The farmer then abandons this patch and clears another patch of forest trees elsewhere for crop production. This practice adopted by farmers has led to tremendous destruction of trees.

(9)**Natural Forces:**

Floods, storms, snow, lightening etc. are the natural forces which damage forests.

Effects of Deforestation:

Large- scale destruction of forests leads to a number of adverse environmental effects; the important effects of deforestation include:

(a) Habitat destruction of wild animals and plants:-Loss of flora and fauna has resulted in loss of biodiversity leading to ecological imbalance. As a result of deforestation, a large number of plant and animal species are slowly becoming extinct because tree-using animals are deprived of food and shelter.

(b)Land degradation:- In the absence of forest cover, a large surface of land area is exposed to the sun; as a result of this the moisture content in the soil decreases drastically causing it to become dry and cracked. Also there is increased soil erosion due to reduction of vegetation cover because water and wind easily wash the soil away

(c) Change in water cycle and reduced rainfall:-Forests contribute to a high amount of rainfall owing to high rate of transpiration and precipitation. In the water cycle, moisture is transpired and evaporated into the atmosphere, forming rain clouds before being precipitated as rain back into the forest. When the forests are cut down, less moisture is evapo-transpired into the

atmosphere resulting in the formation of fewer clouds. Subsequently there is decline in rainfall resulting in drought in the area.

(d) Reduction in the oxygen liberated by plants through photosynthesis.

(e) Increase in pollution due to burning of wood and due to reduction in Car- bon-dioxide fixation by plants.

(f) Decrease in availability of forest products.

(g) Loss of Biodiversity

(h) Scarcity of fuel wood and deterioration in economy and quality of life of people residing near forests

(i) Increased socio-economic problems in the long run:-Indigenous people may be forced to leave the place and hence are uprooted from their culture and traditions. This causes several socio- economic problems in the long run.

(i) Lowering of the water table due to more run-off and thereby increased use of the underground water.

(j) Rise in Carbon dioxide level has resulted in increased thermal level of earth which in turn results in melting of ice caps and glaciers and consequent flooding of coastal areas.

(k) Siltation of rivers and lakes:-In the absence of trees, the soil particles are eroded by rains during run-offs. This eventually leads to the deposition of soil sediments in lakes and ponds.

Control of Deforestation:-

The important measures that are helpful in controlling forest destruction are as follows:-

1. Cutting of trees should be followed by massive plantation
2. Mining activities should be prohibited in areas declared as protected forests
3. The environmental laws and legal provisions should be strictly enforced.
4. Forest extension should be carried out through social forestry, agro forestry etc.
5. Public awareness regarding environmental significance of forests should be created.

Water Resources

Water is the world's most precious resource because the life of animals and plants depends on it. Most industries also require water for various applications, so the global economy depends on it as well. Most of the water on Earth is saltwater, which cannot be used by terrestrial

organisms. Glaciers are the major freshwater resource, while the most important resource for human use is the surface runoff found in lakes and rivers.

Water is a renewable resource through the hydrologic cycle whereby water from the ocean moves onto the land and back again. Sometimes human intervention in the form of dams and pipelines diverts natural water resources to meet local needs. As need for water grow, tension over water resources are likely to increase. Conservation measures and smarter technologies may help to ensure more equitable distribution of water around the world.

Sources and distribution of water

The oceans contain about 0.3 billion cubic miles of liquid water, which is around 97% of all water on Earth. Saltwater contains more than one gram per liter of dissolved solids, of which the most significant is sodium chloride or common salt. This renders it unfit for use by terrestrial animals, including humans, and plants, and for most industrial applications. Freshwater contains less than one gram per liter of dissolved solids, and is the main resource for human use. Most of it is, however, inaccessible because it is locked in glaciers, icecaps, and snow cover in the Polar Regions and elsewhere. Ice and snow account for about 90% of all freshwater. Varying amounts are released into nearby streams at various times during the year where they then become available as a resource. Around 1% of all freshwater is available for human use, amounting to only around 0.007% of the total amount of water on Earth.

Fortunately, water is a renewable resource through the hydrologic or water cycle, which allows the vast body of water in the oceans to be tapped for human use. Water molecules at the surface of the oceans evaporate into the atmosphere and move over the land as droplets of freshwater in clouds. These fall as rain or snow, known as precipitation. Some precipitation evaporates and the rest moves either vertically or horizontally on land. The vertical portion fills up pores in rocks, clay, sand, or soil which, when saturated, are known as aquifers. The water in an aquifer is called groundwater. When an aquifer is trapped between two layers of impermeable rocks, the resulting pressure may create an Artesian well that brings the water up to the surface. Pumps can also bring groundwater to the surface through a well. Groundwater is generally of high quality but care should be taken not to draw off too much, as it renews itself only slowly, particularly in dry regions. Precipitation that moves along horizontally is called surface runoff

and it is carried, by gravity, to the nearest body of surface water, which could be a stream, river, pond, or lake. Eventually it arrives back in the ocean, completing the hydrological cycle.

Surface water is the most important water resource because it is often readily accessible. A stream is a small channel of water that eventually runs into a river. Streams and rivers account for about nearly 500 billion gallons of water, which is about 0.0001% of the total water on Earth, including the oceans. Yet they are probably the most important water source. If rivers and streams were not replenished by precipitation, melting snow and ice, and seeping groundwater, they would probably run dry in a matter of weeks because of human withdrawals.

A pond is a small body of water that is shallow enough for plants to root there. Lakes are larger bodies of water whose depths may vary from a few feet to over a mile, as in Lake Baikal in Siberia and Wular lake in Kashmir. Their areas vary from around an acre to hundreds of thousands of acres like Lake Superior, which is really an inland sea.

Reservoirs are natural or artificial ponds or lakes used for storing water. Lakes and reservoirs account for around 0.28% of the total water on Earth and they are also an important resource for human use.

Uses of Water resources

Agriculture use of Water: Water has always been a vital part of agriculture. Just like humans, crops need water to survive and grow. There are four main areas of water use in agriculture: growing of crops, supplying drinking water to livestock, cleaning farm, buildings and animals, and supplying drinking water for those who work on the farm.

Irrigation: Nearly 60% of the world's freshwater that is used by humans is used for irrigation. Of this water that is applied to crop fields, only about half returns to surface water or groundwater sources.

Aquaculture and Mariculture:

Aquaculture is the farming of animals or plants under controlled conditions in aquatic environments. Aquaculture usually refers to growing animals and plants in fresh or brackish water (water that has a salt content between that of freshwater and that of ocean water).

Mariculture indicates the farming of animals and plants in ocean waters. (Marine means seawater.) Just as on land, aquaculture and mariculture farmers try to control the environmental factors surrounding their crops in order to make them grow quickly and in good health.

Commercial and Industrial Uses of Water:

Besides being vital for human survival, water is also necessary in commerce and in industry. Commercial operations are those that generally do not manufacture a product, but provide a service, such as hospitals, restaurants, and schools. Industry usually involves manufacturing a product. In industry, water helps keep machinery needed for the making of products running smoothly and efficiently. Water can also be a vital part of the product, such as in sports drinks or soft drinks.

Commercial water use:

In modern day, water is essential to people's daily lives. Without water, restaurants could not supply meals or even clean up after the meals, cars would go unwashed, and fires could be disastrous, with no means of dousing the blaze. Green parks, recreational fields, and golf courses rely on water to keep the grass and soil moist and healthy. Roadways would become dirty and grimy in the absence of any water-based cleaning program. Offices would grind to a halt with no water available for drinking and bathrooms, and office buildings, stores, and public and private centers would also be dark places without the water necessary to generate electricity for lighting.

Industrial water use:

Industries require large supplies of water. Machinery relies on water to cool it to a temperature that allows the manufacturing process to keep going. The mining industry needs water to wash off the material that has been brought up from underground in order to sort out the genuine product from other particles. Water is also used to clean machinery, buildings, and even, in the case of the meat processing industry, the carcasses of the cattle, pigs, and other animals that will be trimmed into the items found in the meat section of the local supermarket. In oil producing regions, vast amounts of water are used. As oil wells get older and the underlying oil reserve is tapped, it becomes more difficult to pump out oil that is hiding in cracks in the rock deep underground. One way of getting this oil is to pump water down into the oil formation. The

water can make its way into cracks and crevasses and push the oil out in front of it. The oil is then pumped up using another well. Without this industrial use of water, oil and gasoline would be more scarce and more expensive. The generation of electrical power also makes use of water, to cool equipment and to push the turbines that are the heart of the process that produces electricity. Turbines are turning wheels with buckets, paddles or blades that turn as water moves by converting the energy of moving water to mechanical power.

Consequences of over utilization of water resources

Although water is a renewable resource, the amount available for human use is affected by various threats. These include pollution, urban growth, landscape changes, drought, and climate change. Farming, deforestation, mining, and road-building can all impair the quality of water by allowing too much soil and pollutants to enter local rivers, streams, and lakes. Care must also be taken not too overexploit a water resource.

The water is heavily polluted because of sewage dumping. Many major rivers, such as the Nile, Ganges, and Rio Grande, are showing signs of drying up. One major factor is that water withdrawals are still being poorly managed and controlled. There has also been a trend to increase groundwater withdrawals, where depletions are less obvious than in surface water. But signs of poor management are there in terms of subsidence, poor water quality, and a sinking water table, which is the top part of an aquifer. The relationship between climate change and water resources is currently little understood, although it is more likely than not to lead to water shortages. For instance, while climate change tends to shrink glaciers, the effect is not to enrich nearby water resources. Most of the water released tends to evaporate long before it reaches any drought-stricken areas that need it. Global warming increases the incidence of drought, increasing the pressure on water supplies in dry areas. Meanwhile, extreme weather events stemming from global warming, such as floods, tend to degrade the quality of water resources.

Clearly there is a need to develop water resources in a more sustainable manner, taking account of the various pressures on them. Organizations such as the World Health Organization stress that water policy should be driven more by scientific understanding of the consequences of a lack of adequate freshwater for all peoples, rather than by short-term economic or political goals This includes applying what is known of local water resources and how they interact with

the water cycle. Traditionally, rising demand has been met by storing surface water in a reservoir, diverting flows to drier areas, and using increasing amounts of groundwater. Other techniques, such as rainwater collection, desalination, and water reuse can be added to help protect water resources so they can continue to meet local needs without becoming depleted or degraded.

Watershed Management

A watershed refers to an entire area that drains into a stream, river, or lake, or which is the source of water for an underground water source (an aquifer). Everything in a particular watershed—watercourses, land, vegetation, and human-made structures—can contribute to the water drainage. For example, a shopping center parking lot can be an important part of an urban watershed, as water can easily drain off the concrete into drainage pipes that empty into an adjacent watercourse, or can directly run off into the watercourse. Pollutants can also be carried in the runoff. The various watercourses in a watershed contribute water that ends up emptying into a larger body of water.

Watersheds that include urban areas are especially prone to contamination with runoff of various chemicals from concrete. For example, in many communities, some storm drains have a label warning that dumping is not allowed. This is because the drain empties directly into a nearby watercourse. Nonetheless, entry of polluted water can occur during a heavy rainstorm or because of run off of polluted water from driveways after a car is washed, as two examples. As a result, the polluted water continues downstream. A crude analogy of a watershed is a funnel. The area at the receiving end of the funnel is much greater than the area at the outflow, so the capacity of the funnel to receive water is great. In reality, a watershed is more complicated, since not only can water enter the system at the area corresponding to the top of the funnel, but also at many places throughout the watershed. A watershed is indeed funnel-like, however, since the water ultimately exits from a common site at the mouth of the watershed's main river. If there are a number of urban centers in the area of a watercourse, the water can be unacceptably polluted by the time it empties into the final receiving body of water. Some pollution occurs inadvertently. As one example, leakage of oil and gas from vehicles while parked can be a source of contaminants to an adjacent watercourse, especially during a rainstorm, as the water drains to the lowest point of land, which is often the watercourse.

Watershed management may be defined as a set of resource-management practices that are planned and implemented to provide a sufficient source of quality water to sustain human society and natural ecosystems. The practice of watershed management is interdisciplinary, because it recognizes linkages between land and water resources, and because it seeks to balance the needs of society with the capacities of natural resources to meet them. Land-use practices have impacts on hydrologic processes and water quality. Identifying ways to manage these impacts across a mosaic of soils, terrain, and land-use settings is a key challenge in watershed management. Effective watershed management is an iterative process of assessment, planning, and implementation. It begins with an assessment of current land-use practices and their impacts on water resources. Opportunities to improve land management, considering roles of soil, vegetation, and terrain, are then identified and prioritized. Stakeholder groups should be included in planning, to inform citizens about water-resource management issues and provide feedback to ensure recommendations are realistic as well as effective. A range of computerized tools are available to assist with assessing watersheds and alternative management scenarios. Implementation should include a commitment to reassess water-resource management periodically and develop opportunities for further improvement.

Watershed management is aimed at land and water resources, and is applied to an area of land that drains to a defined location along a stream or river. Watershed management aims to care for natural resources in a way that supports human needs for water, food, fiber, energy, and habitation, while supporting other agreed attributes linked to recreation, esthetics, and/or ecologic function. Because of these multidisciplinary concerns, the development of watershed-management strategies can involve complex scientific and public policy issues. Each watershed is unique in physiography, ecology, climate, water quality, land use, and human culture. Therefore any generalized approach to watershed management must be customized to each setting when put into practice. Watershed management requires a long term commitment that is adaptive to changes in population, climate, culture, and resource-use demands. These issues are unique to each watershed and each nation. Watershed-management experiences from around the globe have dealt with a wide range of issues.

Rain Water Harvesting

Rain water harvesting is defined as method for inducing, collecting, storing and conserving local surface runoff for later use. Three types of water harvesting are covered by rainwater harvesting:

i) Water collected from roof tops, courtyards and similar compacted or treated surfaces is used for domestic purposes or garden crops or for ground water recharge.

ii) Micro catchment water harvesting is a method of collecting surface runoff from a small catchment area and storing it in the root zone of an adjacent infiltration basin. The basin is planted with trees, bushes or with annual crops.

iii) Macro catchment water harvesting also called as harvesting from external catchment is the case where runoff from hill slope catchment is conveyed to the cropping area located at hill foot on flat terrain.

The most common harvesting of rainwater involves water collected from the roof of buildings and storing in rainwater tanks. The collection of rain water from the roofs of buildings can easily take place in cities and towns. All that is necessary to capture this water is to direct the flow of rainwater from roof gutters to a rainwater storage tank. By doing this water can be collected and used for various uses. If people are reliant on collected rainwater and are not connected to a town's water supply, then the water collected will be especially important to them.

Trapping of rainwater either in small ponds or pumping them into the ground directly from many collection localities is in use in some places even today. Collection in open areas may lead to substantial loss of evaporation. With urbanization and high rise building blocking recharge of ground water during rainy days, it may be necessary to pump water collected in individual buildings, directly to the so that the ground water is recharged and used for non rainy days.

Water Conflicts

Water is considered to be a very important natural resource. It is the backbone of all kinds of human activities and plays a very crucial role in the economic development of countries. Because of its necessity, use, and scarcity, conflicts over water are found at all levels- international as well as national. According to many experts water is much more likely reason for countries to go to war than oil. In many countries

inter-state conflicts are due to problems related to irrigation, agriculture, industries, and electricity. India is also facing undesirable situations arising out of the river conflicts among a number of states such as Tamil Nadu, Karnataka, Bihar, Jharkhand, Madhya Pradesh, Rajasthan, Gujarat, Haryana and Punjab. Recent conflict has come up and strained the relations between Rajasthan and Gujarat. Rajasthan has been planning to utilize waters of Mansi Vakal fully for Udaipur and its lakes. Gujarat had raised objections about this project and complained that it will deprive the state of water by obstructing the flow of river Sabarmati. Similarly the Sardar Sarovar Project in Gujarat has become a cause of conflict among the states of Madhya Pradesh, Gujarat, Maharashtra and Rajasthan. Also, the dispute over sharing of water of the river Kaveri has strained the relations between the states of Tamil Nadu & Karnataka. The dispute between the two states is yet to be solved amicably. In fact, it has become worse owing to the bandhs sponsored by the states and violence, both of which have put normal life out of gear. Even recently the Karnataka state had to be put under curfew resulting in tremendous loss to the economy of the state.

Conflicts are brewing now over rivers & river basins shared by many countries around the world also. This is not unexpected given the fact that more than two hundred bodies are shared by two or more countries. Strife over water erupted throughout the Middle East from the water sheds of the Nile to the Tigris & Euphrates Rivers. The Nile which is regarded as the longest river in the world formed the base on which the Egyptians civilization thrived. There is a major ongoing conflict between countries situated along the river & its tributaries regarding the distribution of its water. To solve the national water tensions, countries tend to look beyond their borders for wider reign over water basins they share with other countries.

Natural Resources

These are the components of the environment (*i.e.* atmosphere, hydrosphere and lithosphere) which can be drawn upon for supporting life. These resources can be renewable or non renewable.

a) **Renewable resources**: These resources have the inherent ability to reappear or replenish themselves by recycling, reproduction or replacement. These renewable resources include sunlight, plants, animals, soil, water and living organisms. These are also called as Inexhaustible resources.

b) **Non Renewable resources**: The non renewable resources are the earth's geological endowments i.e, minerals, fossil fuels, non mineral resources and other materials which are present in fixed amount in the environment. These are finite in quality and quantity. These are also called as exhaustible resources.

Energy Resources

The energy resources can be classified in many ways.

a) **Commercial fuels**: These include coal, lignite, petroleum products, natural gas and electricity.

b) **Non commercial fuels**: These include fuel wood, cow dung and agricultural wastes.

c) **Primary energy resources**: These are those resources which are mined or other wise obtained from the environment. These include fossil fuels, nuclear fuels, hydro energy, solar, water, ocean and geothermal energy.

d) **Secondary energy resources**: These are those resources which do not occur in nature; instead these are derived form primary energy resources. These include petrol, diesel, electrical energy form coal, diesel and gas.

e) **Non conventional energy resources:** These include solar, wind, geothermal, ocean, biomass and hydrogen energy.

f) **Conventional energy resources:** These include fossil fuels, hydel power and nuclear energy.

Alternate Energy Resources

1) Solar energy

Solar power refers to the use of energy from the sun. This use occurs naturally as a part of life. For example, plants that are capable of photosynthesis use solar power as a source of the energy they need to survive and grow. Without the energy of the sun warming Earth, no life would exist; surface life would die off quickly and, as the atmosphere cooled, even the deepest parts of the ocean would freeze. More practically, solar power has been harnessed for warmth for thousands of years, and, beginning in the nineteenth century, as a means of generating energy to provide heat, light, and electricity. Solar power is an increasingly attractive alternative energy source as it is a stand-alone energy source; that is, it does not require a connection to a power grid, and the sun provides an unlimited and virtually endless supply of energy. As well,

solar power can be used to supplement electricity generated conventionally using water (hydroelectric power) and burning fossil fuels. In an era when the human-related generation of greenhouse gases such as carbon dioxide have been acknowledged by the Intergovernmental Panel on Climate Change (IPCC) to be a major reason for the increasing warming of Earth's atmosphere that has been occurring for the past 150 years, and which has accelerated since the mid-twentieth century, the use of solar power reduces the greenhouse-gas emissions associated with conventional generation of electricity. This is one reason why solar power is moving more into the mainstream as an energy source.

Solar power is still used today to generate heat in a more sophisticated form known as concentrated solar thermal systems. These consist of an arrangement of mirrors that track the motion of the sun and reflect the sunlight to a small central area. All this reflected sunlight creates temperatures of up to 932°F (500°C), which is used to heat water or oil, which is, in turn, transferred to a facility to generate power. These facilities can convert up to 40% of the incoming sunlight to usable power.

2) Tidal or Wave energy

Large amounts of energy are involved in the motions of ocean water. These motions include steady ocean currents, the repetitive motions of the tides, and the irregular motions of surface waves. For decades, machines have been in development to harvest energy in the form of electricity from these motions. Although a few projects have been in operation since the 1960s, a commercial market for ocean-power harvesting devices has only opened up in the early 2000s. Ocean power is poised to make a significant contribution to a future portfolio of renewable energy sources that will also include wind and solar power. Tidal power has the advantage of being completely predictable: The tides occur with perfect regularity every day. In contrast, waves vary in strength, from a mere ripple to large storm waves. Yet sites with

deep, concentrated tidal currents are not common, and waves wash all shores. There are at least six different technologies for harvesting wave power:

1. Attenuator: Long, tube like floats linked end-to-end by flexible hoses rock as waves pass under them. The motion pressurizes oil, which drives generators. The world's first commercial wave-power farm, along the coast of Portugal, uses this technology and was being installed as of mid-2008.

2. Point absorber: A float bobs up down on the surface of the waves. A vertical shaft is worked by the motion, pressurizing generators.

3. Oscillating wave surge converter: A buoy like arm is tethered to the bottom and waved back and forth like an upside-down pendulum as waves surge past.

4. Oscillating water column: A sealed column with water in its lower portion and air in its upper portion is connected to the sea. Wave action causes the water part of the column to rise and fall, raising and lowering the air and causing air-driven turbines to rotate.

5. Overtopping device: Waves slosh over the top of a barrier and the water flows back to the sea through a turbine.

6. Submerged pressure differential: A drum or tube along which a piston moves is anchored to the ocean floor not far below the surface. Water pressure on the piston varies as waves pass above, causing it to move back and forth in the shaft.

3) <u>Wind energy</u>

Wind is the movement of air from an area of higher air pressure to an area of lower air pressure. The movement of air can be harnessed to provide power. Centuries ago, wind power was used to grind grain and to pump water. In modern times, wind has been harnessed to generate electricity. In the twentieth century, wind power has become more popular, with large arrays of windmills (wind farms) being established worldwide. While in 2008, wind power generated electricity accounts for only about 1% of the world's electricity production, it is becoming increasing attractive as the consequences of fossil fuel generated electricity on atmospheric warming have become recognized. The earliest documented record of windmills

dates back to the late twelfth century in England. However, windmills may have been in use as long ago as AD 500 in Persia, and perhaps even 2,000 years ago in China. Wind can result from the uneven heating of the land and water. Land tends to absorb the heat of the sun more quickly than does water. As well, heat is emitted back to the atmosphere more readily from land than from water. Because warm air rises, cooler air will move in to displace it. This creates wind. Different regions of land can also heat up and cool down unevenly. For example, a sandy desert will heat up and cool down more quickly than a forested area. As a result, wind can be generated over land, as air moves from a relatively cooler area to areas where warmer air is rising. This behavior can occur locally over small distances and, in the case of weather systems, over hundreds or thousands of miles/kilometers.

The conversion of wind into electricity begins when the moving air contacts the blades of the wind machine (turbine). The angle of the blades slows the movement of the air. The design is similar to the wings of an aircraft. The air passes more slowly over one surface of a blade than over the opposing surface. This causes a difference in air pressure, and the movement of air from the higher pressure surface of the blade to the lower pressure area. The blades do not rise into the air as do airplane wings, but rotate about the fixed central point. The rotating blades are attached to a shaft. As the shaft turns, an electrical generator positioned at the top of the wind machine produces electricity. A cable that runs down the center of the machine conveys the electricity to the ground, where it feeds into a transmission line. The electricity can then flow into the conventional electrical grid to supplement the conventionally generated electricity, or can be directly used on-site. Traditionally, both the first windmills and modern electricity-generating turbines have had one of two designs. In the horizontal axis design, the blades are oriented horizontal to the ground and perpendicular to the central shaft. In the vertical axis design, the blades are positioned vertical to the ground and parallel to the central shaft. The horizontal axis version is the most widely used. The turbines that are used in wind farms can be very large, as tall as a 20-story building with three blades that are hundreds of feet long. Even larger versions exist; the blades on the largest turbines are over 300 ft (90 m) in length, longer than a football field. The electrical output from a wind farm can be considerable.

4) <u>Geothermal energy</u>

Geothermal resources refer to the heat energy generated in Earth. Though it is more a potential than a reality as of 2008, geothermal resources can also refer to heat energy that can be

gathered from the atmosphere and ocean. The energy stored in the hot water present at sites where steam vents out from the subsurface is an example of a geothermal resource. As of 2008, global geothermal energy production is approximately 8,000 megawatts (MW), of which about 2,800 MW is produced in the United States, and which represents the third-largest renewable energy source in the United States after hydroelectricity and the burning of biofuels. Still, this represents less than 1% of the total energy production in the world. Interest in geothermal energy is growing because, in contrast to the energy produced by the burning of fossil fuels, it is a renewable resource and can be a source of much less carbon dioxide (CO_2) than conventional sources of energy. The reduction in carbon dioxide is beneficial in helping curb global warming, which is the warming of Earth's atmosphere and oceans that has been occurring since the mid-nineteenth century and accelerating since the mid-twentieth century.

Geothermal energy is created by heat from the core of Earth. The core is located almost 3,700 mi (6,000 km) below the surface. Temperatures in the core reach 9,000°F (5,000°C), which is high enough to melt the rock. The melted rock is called magma and is familiar as the molten material ejected from erupting volcanoes. Volcanoes are one example of regions of Earth where the magma can contact the surface, through cracks in the overlying surface crust (the mantle). In other areas, the magma comes close to the surface and can heat the underground water. The steaming hot water finds routes to the surface through cracks in the rock; these are the vents that can be harnessed to provide geothermal power. Areas where many vents are found are called steam fields. Another approach is to drill wells down to reservoirs of the hot water, which can then be pumped up, or, if the underground pressure is sufficient, spontaneously pushed upward to the surface. A geothermal facility such as The Geysers is an example of a steam plant. The extremely hot water (over 572°F, or 300°C) is used to turn turbines, which in turn drive generators to create electricity. The main byproduct of the process is water vapor; the amounts of undesirable carbon dioxide, nitric oxide (NO), and sulfur (S) are nearly 50 times less than the amounts emitted by conventional electricity generation involving the burning of fossil fuels such as coal.

5) <u>Biomass based energy</u>

Biomass defined as living matter or its residues is a renewable source of energy. Biomass has been an important source of energy for man kind from ancient times. For today's needs biomass is often not a convenient fuel. It has to be converted to suitable and convenient state before it can

be used. Some of the important energy sources which originate basically from photosynthetic activity of green plants:

a) Biogas: It consists mainly of methane which is produced when organic matter decays under anaerobic conditions. Cow dung, feacal matter and other biodegradable wastes are allowed to decay under anaerobic conditions in digesters equipped with device to collect methane thus formed. This residue is exceedingly rich in plant nutrients which can be used as fertilizers. Methane as a fuel is pollution free, clean and cheap source of energy since it is obtained from the wastes which we have to dispose of.
b) Petro plants: A number of plants belonging to families Euphorbiaceae, Asclepiadaceae, Apocynaceae, Convolvulaceae etc. possess hydrocarbons in their saps and latex. These can be used to produce liquid and gaseous fuels.
c) Dendrothermal energy: Denuded waste lands can be used to produce fast growing shrubs and trees with high calorific value. These can be used to provide fuel wood, charcoal, fodder and through gasification system gases to be used where fuel wood and charcoal is not convenient. Similarly baggasse, the pulp and waste discarded after expulsion of juice from sugarcane during the manufacture of sugar can be used to generate energy for local use.

Conventional Energy Sources

1) Coal

Forty percent of the world's electricity is produced by burning coal, a black or brown rock consisting mostly of carbon. Burning coal releases pollutants, including sulfur dioxide and mercury, which can cause disease, acid rain, and global warming. However, coal is one of the cheapest sources of energy and its use is increasing around the world. Coal is a flammable black rock consisting mostly of carbon. It is formed naturally from the compressed, chemically transformed remnants of ancient plants. Most coal derives from plants that grew in vast swamps about 286–300 million years ago, a geological period named the Carboniferous because of its association with coal. In the western United States, important coal deposits also formed during the later Cretaceous and Tertiary periods. Coal is not being formed at a significant rate today, so it is not classified as a renewable resource. Because the plant matter in coal was laid down by swamps, it tends to occur in extensive horizontal layers called seams or beds. After accumulating

in thick beds, the dead plant materials that would eventually become coal were typically covered by sediments (rock particles) that hardened into layers of sedimentary rock. To obtain coal today, miners must typically either tunnel through this rock, a practice known as underground mining, or strip it entirely away along with the overlying landscape to expose the underlying coal seam. The latter practice, known as strip mining, includes the practice of mountaintop removal, in which the upper portions of entire mountains are removed and dumped into adjacent valleys. There are several grades or qualities of coal, distinguished by hardness and composition. Softer, lower-carbon coals burn less well and pollute more, but are in greater supply. Lignite, the lowest grade of coal, is 40% to 70% carbon by weight; bituminous coal is from 70% to 90% carbon; and anthracite, the hardest, highest-carbon coal, is 90% or more carbon. Although estimates of world coal resources are based partly on guesswork, most experts agree that many billions of tons of coal remain in underground deposits.

Coal is particularly important in making electricity. Heat from burning coal is used to make pressurized steam, which turns turbines that turn generators that produce electricity. In 2007, 40% of world electricity came from coal, 20% from natural gas, 16% from hydroelectric dams, 15% from nuclear power, 7% from oil, and 2% from miscellaneous sources, including non-hydro renewables.

2) <u>Petroleum</u>

Petroleum resources are naturally exposed to the atmosphere as the product of the composition and geology of Earth itself. Many of the regions where accumulations of petroleum exist were discovered long ago as various hydrocarbon fluids and gases seeped to the surface, where they either pooled or vented to the atmosphere. In its raw form, petroleum presents nominal environmental risk in highly localized areas. The primary environmental concern with the use of petroleum resources comes from the combustion process when used as a fuel. There are other concerns related to the means required to explore for, find, develop, and transport petroleum products to market. However, the use of petroleum as a prime source of energy is not without environmental benefits, particularly when compared to the fuel sources it displaced as technology began to advance and make petroleum a practical and economic alternative. Petroleum, or crude oil, exists in compositions of carbon (C), hydrogen (H), and other elements over a broad range of fluids, from very light oils to thick viscous tars to solid asphaltenes. The

chemical composition of petroleum is generally 83–87% carbon, 10–14% hydrogen, 0.01–2% nitrogen (N), 0.1–1.5% oxygen (O), and 0.5–6% sulfur (S) and may include trace quantities of various metals. Gases may break out of the volatile fluid either within Earth's substrata or once on the surface depending on temperature and pressure. In any form, petroleum is flammable and is toxic to some degree if ingested and can be fatal in extreme situations.

3) Natural Gas

Liquefied Natural Gas (LNG) utilization enables the most environmentally friendly fossil fuel available to contribute to meeting growing energy demands from a resource that would otherwise go unused, thus requiring other fuels to fill the need. The process of producing and using LNG has unique environmental considerations that require careful study and management, as projects are evaluated and implemented to meet growing energy demands. The release of greenhouse gases into the atmosphere has been a naturally occurring phenomenon since Earth formed and life began, with gases released due to biodegradation of plant and animal matter, the digestive and respiratory processes of living beings, and naturally occurring hydrocarbon seepages from within Earth. Natural gas discharges also occur as the result of moving water, oil, and other resources from beneath Earth's surface. Gas exists in solution within water and/or oil while in the reservoir and is released when produced to the surface. Liquids are comparatively easy to capture and transport using readily available technology. Solution gas was routinely released into the atmosphere until technology enabled its capture and delivery to the consumer, while supplanting less clean burning fuels when pipelines could be installed. The liquefaction of natural gas enables transport from areas where pipelines do not exist and reduces the volume of gases released to the atmosphere. Environmental concerns relative to LNG come from the process of converting natural gas to a readily transportable state, transportation, and introduction into a delivery system. The steps in the process include:

1. Processing to remove unwanted elements and impurities,
2. Liquefaction,
3. Transportation in a liquid phase,
4. Conversion back into a gas phase and pipeline distribution to homes and industry as the end users. Liquified natural gas is 90% methane (CH_4) and is odorless, colorless, non-corrosive, non-toxic, and non explosive in an unconfined environment. Liquefaction is a thermodynamic process requiring energy consumption to chill the gas causing the phase change to a dense liquid

at −160°C (–256°F) at atmospheric pressure by compression to high pressure and rapid expansion back to atmospheric pressure. The density of LNG is 600 times that of an equivalent volume of natural gas at atmospheric pressure.

LNG is shipped at a constant atmospheric pressure, creating a boiling cryogen in a liquid phase in specially insulated and designed tanks. The process requires venting all gas produced as the liquid boils. LNG is then delivered to a terminal, vaporized back into a gas phase, and shipped to its end users in homes and industry.

4) <u>Nuclear energy</u>

Nuclear power is energy from controlled reactions involving the nuclei (dense, tiny centers) of atoms. Nuclear power plants are large industrial facilities fueled by radioactive metals such as uranium 235 and plutonium. Uranium 235 is obtained by refining natural ores, while plutonium is an artificial element created by exposing a common but otherwise mostly useless form of uranium (uranium 238) to radiation, usually in nuclear power plants. Most nuclear power plants are fueled by uranium 235. In a nuclear power plant, nuclear fuel is concentrated in a structure called a nuclear reactor. In the reactor, radiation from disintegrating fuel atoms is made to impinge on other fuel atoms. This triggers further disintegrations, leading to a sustained reaction that releases a flow of energy. This energy is harvested as heat, which in a typical plant is used to boil water to make steam to spin turbines that turn electric generators.

Growing Energy Needs

Global Level

Energy is derived from non renewable (conventional) and renewable (non conventional) resources. The conventional resources include fossil fuels i.e oil, coal and natural gas which is in the process of depletion and their formation takes million of years. Renewable resources include solar energy, wind energy, water energy and biomass. Approximately 80% of the world's energy is produced by fossil fuels, but some countries like France, have established nuclear reactors which produce enough energy to meet 70% of country's requirement. World demand for fossil fuels is increasing day by day and the demand will continue to grow. Of the developing countries, China has the highest per capita consumption of energy. For India per capita consumption is lower than that of China. Among non- conventional resources, hydropower is the largest. Hydropower projects are in operation both in developed and developing countries .Hydropower potential is huge and at present only 15-20% of the potential in the developing world is being utilized. Wind power also has great potential and is a fast growing resource. Wind mills and sails are supplying near about 10% of worlds electricity. The use of solar energy is through photovoltaic cells which converts light directly into electricity and the photovoltaic production is increasing day by day. Fifteen European Union Nations, including Spain and Germany, who are world

leaders in renewable sources of energy, have committed that by 2020, they would generate 20% of the energy using renewable resources.

Indian Scenario

Coal, oil, gas and water constitute the main sources of energy in our country. Traditionally India has been deficient in power generation vis-a vis its demand. The main share of energy comes from coal (56%) and petroleum (32%). Apart from commercial energy, a large amount of traditional energy is derived from the fuel wood, agricultural waste and animal waste. About 5% of world's coal is found in India. In India industrial sector is the largest consumer of conventional energy followed by transport sector. A deficit of 220 million tons of coal was projected for the year 2011-12.In the domestic sector, the consumption of natural fuel (mostly wood) energy is very high.

The Integrated Energy Policy Report (IEPR) PREPARED by the Planning Commission has provided a long term vision for the next 25 years. The aim is that at least 10% of the power generation installed capacity in the country should come from renewable sources by the end of the 11th Plan Period. With petroleum prices touching $80 a barrel and our import dependence on crude oil at more than 70% and rising, alternate energy resources are no longer just an option. India has put in place several renewable initiatives and the country is now the world's fourth largest generator of wind energy with an installed capacity of 7,093MW. The wind power potential of our country is estimated to be about 20,000 MW, while at present we are generating about 1,020 MW. The largest wind farm of our country is near Kanyakumari in Tamil Nadu, and it generates 380-MW electricity. In the outskirts of Delhi a solar-powered sustainable building with passive designs such as sky lighting, insulation, double –glazed windows, and underground tunnels into which air is sucked and distributed similar to ancient underground cellars that were cool in summer and warm in winter. The complex saves 40% to 50% of energy costs incurred by conventional buildings.

CREDIT III: BIODIVERSITY AND ITS CONSERVATION

TERMS TO REMEMBER	
Biodiversity	It refers to the variety of different species or living organisms.
Poaching of wildlife	Means hunting of wildlife.
Threatened species	Those species which are under threat is known as threatened species.
Endangered species	These are those species whose number have been reduced to a critical level.
Extinction	Complete disappearance of a species from this earth.
In-situ conservation	Conservation of species in its own natural habitat.
Ex-situ conservation	Conservation of species outside their natural habitat.
National park	Area which is totally prohibited for human activities so as to protect and give natural habitat to the endangered species.
Exotic species	Are those species which are not native and are introduced from another ecozone.
Endemic species	The species which are confined to a particular area is known as endemic species.

3.1. DEFINITION, LEVELS AND VALUES

DEFINITION

Biodiversity is derived from Greek words Bios meaning life and diversity meaning forms.Biodervisity is the total variety of life on over planet. The total number of races ,varieties or species i,e the sum total of various types of microbes, plants and animals present in a system is reffered to as biodiversity.

LEVELS OF BIODIVERSITY:

1. Genetic diversity (Alpha):

The total number of genes, also known as genetic diversity refers to variation of genes within a species which differ slightly from each other in one or more characters such as shape, size, disease resistance and ability to withstand vagaries of the environmental conditions. Genetic diversity is expressed in the form of breeds, races, varieties and forms.

2. Species diversity (Beta): The biodiversity is usually studied in terms of species diversity. The total species or the species diversity refers to the variety of species in a region. A community consists of a variety of species of plants and

animals. This 'variety' is referred to 'diversity' and is also known as species diversity of the community. Species diversity is dependent on two variables, the number of different species in the community (species richness) and distribution of individuals of species within the community (species evenness).

3. **Ecosystem diversity (Gamma):** Ecosystem diversity involves both species as well as genetic diversity of the community. This type of diversity is found with different types of ecosystems like i) Terrestrial ecosystems e.g. forest, grassland and desert ecosystems. ii) Aquatic ecosystems e.g. freshwater and marine ecosystems. iii) Wetlands e.g. mangroves and estuarine ecosystems.

VALUES OF BIODIVERSITY

COMMERCIAL VALUES: Many of our products like cereals, spices and medicines came into existence accidentally as these plants and animals produce chemicals for their safety and attraction. Otherwise we would not have considered these plants and animals valuable. As humans we are wholly dependent on this diversity of plants and animals. A large number of products are derived from forests including timber, gum; resins, oils, waxes; dyes and rubber are of immense commercial value. The much of energy needs of the rural masses are still being met by forests. In China (2016) at one of the health resorts, fresh oxygen filled in the cylinders is provided to the tourists. The oxygen is filled at pollution free areas into the cylinders and is being provided to the tourists at a cost. Moreover, the animal products like hides, horns, ivory, fur etc are a good source of income. However, killing or capturing or uprooting etc. of any wild plant or animal is prohibited under law. A captured Rhinoceros costs more than rupees 35000/= and similarly monkeys are sold at a good rate in the market. Domesticated animals have given us hormones, enzymes and food products while the fungi and microbes provide life saving drugs such as antibiotics. From scientific experiments like testing of any new drug and new surgical methods are often tested on animals. The common Rhesus monkey has been subjected to many such tests.

ECOLOGICAL VALUES: Healthy ecosystems are vital to life. They regulate many of the chemical and climatic systems that make available clean air and water and plentiful oxygen. Forests, for example, regulate the amount of carbon dioxide in the air, produce oxygen as a byproduct of photosynthesis (the process by which plants use sunlight to create energy), and control rainfall and soil erosion. These forests also provide humus to the soil through leaf litter and add nutrient strength to the soil. One of the strengths of our agriculture is the soil nutrients. These nutrients in the soil are being made available to the plants through biogeochemical cycles. These cycles are driven by soil microbes. A gram of fertile agricultural soil contains 2.5 billion bacteria, 4.0 lacs fungi, 50,000 algae and 30,000 protozoa. All these have their role to play in the soil and its fertility and they interact with each other. These micro organisms are also helpful in decreasing the toxicity of the soil which comes through the waste products. The wetlands which harbor rich plant diversity filter large amount of industrial and sewage waste helps in increasing the quality of run-off water from these wetlands. We depend on the micro-organisms in scavenging the organic and inorganic materials present in our

environment like solid waste decomposition by the action of bacteria. Recently in the year 2016 a new bacterial strain has been discovered which is responsible for the degradation of the plastic waste.

SOCIAL AND RELIGIOUS VALUES: An important place of honor has been given to animals in the galaxy of Hindu gods and their associates. There are animal gods like hanuman (Monkey), ganapati (mice), Lord Vishnu sleeps on the snake, rides on the garuda, while the god ishwara and his sons ganapathy and Subramanayam have the bull, mouse and the peacock as their vahans (ride) and goddess durga has selected the tiger as her animal to ride. The wild life of India has interacted with our culture as well. The early Indus civilization shows the use of animal symbols in their seals. Their mythology and literature are full of accounts of these animals.

AESTHETIC VALUES: The ornamental plants are still a lucrative commodity today. Unusual and interesting flora and fauna can be very important attractions, especially when combined with scenic landscapes. The wildlife gives recreation to people of all walks of life. Bird watching is a very popular pastime among many people. The aesthetic value of the biodiversity also gives us some sort of feeling the pride. The Kashmir Stag is pride of the people of the state. Similarly the national animal tiger represents the country India. These protected indigenous plants and animals give people a sense of satisfaction that our place or region is still rich in the biodiversity. These wild places which harbor rich biodiversity are also aesthetically pleasant and provide shelter temporarily to get away from the hustle and bustle of the cities.

There are many examples of the benefits and values of the biodiversity. Today scientists believe that more is unknown than known. These values of plants and animals including microbes are still unknown and awaits discovery. However, if this biodiversity is not conserved today, including the biodiversity which at present does not provide any benefit to us, may in future be a revolutionary item for the humans.

BIODIVERSITY AT GLOBAL, NATIONAL AND LOCAL LEVELS

Biological diversity has been the back bone of human food, wealth and livelihood security systems, ever since the beginning of human civilization. Interaction between the living world and human societies led to the domestication of a wide range of plants and animals. Expansion of human settlements and increasing specialization of agriculture, particularly during the 20^{th} century led to destruction of habitats rich in biodiversity and the narrowing of the composition of the food basket. The loss of biodiversity has to be seen against a greater need to produce food and other commodities under condition of expanding biotic and abiotic stresses and shrinking per capita availability of arable land and irrigation water. Also there are real possibilities for diverse changes in precipitation, temperature, ultraviolet-B radiation and sea level rise. The feedstock for the biotechnology industry is also biodiversity. Under such circumstances, the loss of every species and gene limits our options to shape our future. Therefore it is imperative upon all the nations to prevent continuing genetic erosion and to promote concerted efforts to conserve biodiversity by

all nations, acting both individually and collectively. The various steps taken at global, national and local levels to safeguard the biodiversity resources are:

A global Convention on Biodiversity (CBD) was adopted at the UN conference on environment and development in 1992. By January 2000, over 170 nations had ratified the CBD is a unique international agreement, since it provides a framework for integrated action in biodiversity conservation, sustainable use and equitable sharing of benefits. Political, public and media attention to biodiversity conservation has certainly increased since the CBD came into force. Many countries have enacted legislation to give effect to its provisions. Also, an internationally agreed protocol, titled the Cartagena Protocol on bio-safety was adopted by 130 countries at Montreal in January 2000, as proposed under article 19 of CBD. The bio-safety protocol is the first treaty under CBD. While awareness of the importance of biodiversity exemplified by WHO Chiang Mai declaration "save plants to save lives" has grown, political and public action in implementing the provisions relating to equitable sharing of benefits of biodiversity.

One attempt at a more holistic approach was the India's national Biodiversity strategy and Action Plan (NBSAP). The aims of this NBSAP were to prepare action plans including for local sites (village, district, and micro-watershed), all states and Union territories, inter-static eco-regions (e.g. Western Ghats) and cross-cutting themes. The plans were supposed to outline actions for conservation of biodiversity, sustainable use of bio-resources, and equity in using and benefiting from these resources, what resources are required, what legal and policy changes are needed, and so on. As far as possible, NBSAP will also indicate reorientation of existing plans and budgets.

Biodiversity-rich but biotechnology poor countries are adversely affected by the prevailing non-adherence to the ethical and equity principles in benefit sharing contained in Articles 8 and 15 of CBD. The invaluable contributions of tribal and rural families to genetic resources conservation and enhancement have been recognized in the CBD. Biodiversity conservation cannot, however, happen unless it becomes a mass movement and unless laws, policies, technologies, development projects and demographic trends that are currently threatening it are tackled properly. Indian legislation in biodiversity emphasizes the role of tribal and rural women in conserving and improving biodiversity.

3.2. THREATS TO THE BIODIVERSITY

Main threats are:-

1. Population growth
2. Resource consumption
3. Climate change
4. Global warming
5. Habitat conversion

6. Urbanization
7. Over exploitation of natural resources
8. Environmental degradation

HABITAT LOSS:

During the recent past, the habitat that too undisturbed have become rare and we are losing it at a very fast pace due to increased resource consumption. The growing needs of human beings require more food, housing, electricity and other materials for sustenance. Cutting of forest for agriculture and housing, construction of dams for electricity generation and construction of roads which resulted in shrinkage and fragmentation of habitat. All these factors threaten biodiversity at gene, species and ecosystem level hampering the provision of key products and services..

POACHING OF WILDLIFE:

The killing of animals for meat, skin and bones etc. is an age old practice. This has led to unlimited slaughter of many animals by man to meet his materialistic ends. For instance, elephants are poached for tusks, tigers and big cats for skin and rhinoceros for horns. The increasing costs of these products have placed these animals under threat. As a consequence of poaching, the populations of elephants, rhinos and other animals decreased considerably

CONFLICT BETWEEN MAN AND WILDLIFE:

It refers to interaction between wild animals and people and the resultant negative impact on people or their resources, or wild animals or their habitat. It occurs when growing human population overlap withreduction of resources,habitat destruction etc.Its main causes are:-

I.dwindling habitats.

2.Man-eating tendency

3.Scarcity of food

4.Electric wiring

5.Lack of corridors

POLLUTION OF VARIOUS HABITATS:

The pollution of the environment is one of the most horrible ecological crisis to which we are subjected today. We also know that three basic facilities for living organisms are air, land or soil and water. During the past these facilities were pure and almost undisturbed. However, the situation is different today. With the progress in the field of science and technology, the pollution of the environment and serious ecological imbalance is proving disastrous for the survival of

the human beings as well as other living creatures which are necessary to withstand for the functioning of the ecological systems (Remember the role of animals in the food chain and food web). Pollution had invaded and has exploited every bit of natural resources. The craze of progress in agriculture, industry, transportation, and technology has created adverse effects on all living organisms on the biosphere.

CATASTROPHIC PROCESS:

The demand for food has increased as a result of rise in human population and hence fertilizers were used to increase food production. Fertilizers have boosted the production of food grains and vegetables to many times but the world have discovered that this revolution had a costly side, the destruction of the environment. The fertilizers which were used got washed down into streams, rivers, lakes, seas and ocean. These at the first instance have depleted the oxygen of the water and made it difficult for fishes and other water animals to live in. Several lakes have been called as biologically dead which receive such kinds of wastes. In addition insecticides, pesticides have also caused the aquatic animals to perish. On the other hand radioactive pollution, thermal pollution, marine pollution, smoke pollution, smog pollution, metal toxicity, acid rain pollution has arrested the fragile ecosystems on the biosphere and has posed the threat of extinction of mankind and several other species of life.

ACCIDENTAL CAUSE:

Calcutta, which is one of the most polluted cities in India, releases 1100 tonnes of particulate matter every day from industries, energy houses and other sources. It was estimated that carbon dioxide concentration of 38ppm due to auto exhausts during peak traffic hours at selected points was the highest intensity of air pollutants recovered in India. In China about 60million tonnes of coal was extracted which polluted the overall sky. In Beijing 39 tones of soot per sq.km.descends each month due to which it becomes dusty, sooty, cold and dry in winter. Here people wear masks of surgical cotton to prevent dust from entering the lungs. In many countries motor vehicles have no emission control equipment and so the emissions from their vehicle contribute to acid rain. The worst air pollution case in the Meuse Valley of Belgium in 1930 where 60 people died. A deadlier London smog in which about 4-5 thousand people died from respiratory ailments. The worlds worst nuclear disaster at Chernobyl in the Ukraine area. The Bhopal gas tragedy which took place in India in which almost 3200 people lost their life. There are other several hundred episodes which have resulted into loss of life and property due to pollution of the environment.

BIOLOGICAL INVASION:

DEFINITION: **The process by which species (or genetically distinct populations), with no historical record in an area, breach biogeographic barriers and extend their range.**

The entry of *Azolla* (water plant) in the Kashmir lake waters is a case of biological invasion. In Jammu the listed invasive species are 75% are herbs, 10% shrubs, 5% grasses, 4% trees and 3% climbers and sedges. Maximum contribution to the invasive alien species is from American region. In July 1996, the United Nations Conference on Alien Species identified invasive species as a serious global threat to biological diversity. Then in April 1997, more than 500 scientists called for the formation of a presidential commission to recommend new strategies to prevent and manage invasions by harmful exotic species in the United States. Already, many countries attempt to maintain their biological heritage. Unfortunately, for a variety of reasons, such tactics have failed. Without greatly increased awareness and coordinated efforts, the devastating damages will continue.

Exotic species have contributed to the decline of 42 percent of endangered and threatened species in the U.S. At least 3 of the 24 known extinctions of species listed under the Endangered Species Act were wholly or partially caused by hybridization between closely related exotic and native species. After habitat destruction, introduced species are the second greatest cause of species endangerment and decline worldwide far exceeding all forms of harvest. As Harvard University biologist E. O. Wilson put it, "Extinction by habitat destruction is like death in an automobile accident: easy to see and assess. Extinction by the invasion of exotic species is like death by disease: gradual, dangerous, requiring scientific methods to diagnose."

CONCEPT OF THREATENED SPECIES

Threatened species are those which are under threat due to various natural and anthropogenic activities. If not protected all the species may become extinct if these casual factors continue operating. The International Union for Conservation of Nature and Natural Resources (IUCN) is maintaining a Red Data Book which contains a data of animals which are known to be in danger. The classification is based on the following factors:

1. The present and the past distribution of the species.
2. The decline in the population of the species.
3. The biology and potential of the species and
4. The availability and quality of natural habitat of species.

The three categories depending upon the degree of danger to them includes the vulnerable, endangered and rare species as given below:

- **Vulnerable (VU):** Species is vulnerable when it is not endangered but facing high risk of disappearance. Some of the common vulnerable animal species in India are: Golden languor, Leopard cat etc.
- **Endangered (EN):** Species whose number has been reduced critically or whose natural habitats have been adversely affected by natural and artificial means. These are near to extinction. The important ones from these are: Hanglu, Snow leopard, Nilgiri langur Red panda, Musk deer, Peacock, Himalayan monal pleasant etc.

- **Rare (R):** Species which are less in number but are scattered throughout the world. These does not satisfy the criteria for endangered or vulnerable but they are at risk.Some Indian rare species are: Indian Desert cat, Wild yak, Markhor etc.

3.3 CONCEPT OF ENDEMIC SPECIES

Endemic species are those species which are confined to a particular area like country, island and mountain area etc. They are found in a particular environment only. Little variations are found in such species. Most of the endemic flowering plants in India are reported from North East India, the Western Ghats, North West Himalayas and Andaman and Nicobar Islands. Out of 45000 flowering plants found in India 15000 species (i.e. 33%) are endemic. More than 60% of amphibian species are endemic and half of the lizard species are endemic.
Some examples of endemic species are: Banyan, Butter cup, Shisham, Bael (*Aegle*), Dhak (*Butea*) etc.

CONCEPT OF EXOTIC SPECIES

Also called as introduced species or alien species or non-indigenous species.Exotic species are those species which live outside their native distributional range and which has arrived either accidently or intentionally.Examples are Water Hyacinth, Congress grass etc

Effects of species introduction:
There are many instances when introduction of exotic species has caused extensive damage to natural biotic community of the ecosystem. Species introduction can have drastic social, economic and environmental effects. Some of these are positive but more often they are negative, such as the disruption of the natural balance of ecosystems.

HOT SPOTS OF BIODIVERSITY

DEFINITION: Hot spots are those sites that are characterized by high concentration of endemic species and are facing serious risk of disappearance due to rapid rates of habitat modification or loss. The concept of hot spots of biodiversity was given by Norman Myers in 1988.

CRITERIA: An area is designated as hotspot when it contains at least 0.5% or 1500 species of plant species as endemic and has lost at least 70% of its primary vegetation. Currently there are 34 hot spots of biodiversity all over the world that represents just 2.3% of earths land surface but they support more than half of the world's plant species as endemics. There are 49,955 endemic plant species or 20% of world's recorded species. Of the 34 global biodiversity hotspots, four are present in India represented by the Himalaya, the Western Ghats, the Northeast India and the Nicobar Islands. Some of the important global biodiversity hot spots are:

1) Brazil's Cerrado.
2) Central Chile.
3) California floristic province.

4) Madagascar.
5) West Afarican forests.
6) Cape floristic province.
7) South central China.
8) Eastern Himalaya of India.
9) Western Ghats of India.
10) Coastal forests of Tanzania/Kenya.

HOT SPOTS IN INDIA

Out of 34 identified hot spots, 4 are found in India. These are

i) **Eastern Himalaya** which extends from North Eastern India to Bhutan. The Eastern Himalayan hot spot is rich in endemic plants and the temperate forests are found at the height of 1780-3500 meters above sea level. Here many deep valleys are also found.

ii) **Western Ghats** covers the evergreen forests in the states like Karnataka, Maharashtra and Kerela that lies at height of about 500-1500 meters above sea level. The two main centers of biodiversity are Agasthyamalai hills and Silent valley.

iii) **Northeast India** is one of the most biodiversity rich regions of tropical forests in India. Northeast India, a part of the Himalayan and Indo-Myanmar "hotspots," is of special biodiversity interest.

iv) **Nicobar Islands** covering 8,249 km^2 geographical area with a coastline of 1,962 km. The terrain of Andaman Islands (part of Indo-Burma Biodiversity Hotspot) that has been formed from the fragments of a continental land mass is in contrast to the Nicobar Islands (part of Sundaland Biodiversity Hotspot), which were formed due to volcanic activity. These are lying in North-South direction and simulating an arc stretching over a length of about 912 km and maximum width of 57 km.

Table: Diversity of plants and animals in India.

Group	Number	% of world species
Mammals	350	7.6%
Birds	1224	12.6%
Amphibians	197	4.4%
Reptiles	408	6.2%
Fishes	2546	11.7%
Flowering plants	15000	6%

Sources: Indira Gandhi Conservation Monitoring Centre (IGCMC), New Delhi & IISc.

3.4. CONSERVATION OF BIODIVERSITY

DEFINITION: Conservation is defined as the management of human use of the biosphere so that it may yield the greatest sustainable benefits to the present generation, while maintaining its potential to meet the needs and aspirations of future generations, thus conservation embraces in itself preservation, maintenance, sustainable utilization, and restoration of the natural environment.

The conservation of plants and animals can be studied under two headings:

IN-SITU CONSERVATION

In-situ conservation is the conservation of species in its natural habitat. In-situ conservation is being done by declaring area as protected area: in India following habitats are being maintained:

1. **National parks:** A national park is an area which is totally prohibited for human activities like forestry, grazing, cultivation etc. and is reserved for the betterment of wildlife. National park is an area to preserve for all times which contains an object of geographical, historical, and biological importance as a national heritage for the benefit of education and enjoyment of people. It is enacted or promulgated by central Legislation.
   As of August 2015, there were 105 national parks. All national park lands then encompassed a total of 40,500 km^2, comprising 1.23% of India's total surface area.
2. **Sanctuaries:** Wildlife Sanctuary is an area set aside for the preservation and conservation of wildlife where man can visit as a privileged visitor without effecting wildlife. In this, quality of environment is managed or unproved by wildlife Management Techniques or practices. It is enacted by the state Legislation.
   There are about 531 wildlife sanctuaries covering an area of 117607 km^2, comprising the total geographical area of 3.58% of India.

Protected Areas of India (as on 14 August, 2015)

	No	Area (km^2)	% of Geographical Area of India (%)
National Parks (NPs)	103	40500.13	1.23
Wildlife Sanctuaries (WLSs)	531	117607.72	3.58
Conservation Reserves (CRs)	65	2344.53	0.07
Community Reserves	4	20.69	0.00
Protected Areas (PAs)	**703**	**160473.07**	**4.88**

Source: National Wildlife Database Cell, Wildlife Institute of India

1. **Biosphere Reserves:** Biosphere Reserve includes natural, minimally disturbed, man modified and degraded ecosystem. These are meant for conservation of natural areas and the genetic material which is contained within

them.Biosphere reserve programme was established in 1971 under MAB (man and biosphere) programme of UNESCO.Presently worldwide there are 621 biosphere reserves in 117 countries. In India presently we have 18 biosphere reserves.Nilgari being the first one and Panna the latest one.Out of 18 biosphere reserves ,9 are part of the world Network of biosphere reserves on UNESCO Man and Biosphere Programme list.These are:-

i. Nilgari biosphere reserve
ii. Gulf of Manar biosphere reserve
iii. Sunderbans biosphere reserve
iv. Nanda devi biosphere reserve
v. Nokrek biosphere reserve
vi. Pachmari biosphere reserve
vii. Simlipal biosphere reserve
viii. Achanakmar-Amarkantak biosphere reserve
ix. Nicobar islands biosphere reserve

2. EX-SITU CONSERVATION

Ex-situ conservation is the method of conservation where the plant or animal is not conserved in its natural habitat, but can be conserved out in the habitat under controlled conditions under human supervision. Few noteworthy points of ex-situ conservation are:

1. Botanical gardens: A botanical garden is a living collection of plants and which provides material for a number of studies. A botanical garden is said to be well established if it has lakes, ornamental flower beds, glass houses, herbaria, libraries and laboratories associated with it. In botanical gardens under controlled conditions, those plants are grown which cannot grow normally. After the growth of these plants, they are reintroduced in the original area to grow and so help in plant introduction. This plan is very helpful in propagation of economically important plants like tea, coffee, rubber, etc. Moreover, botanical gardens have elaborate facilities of glass houses and green houses.

2. Zoological gardens: or park which is common homes for living collections of animals. Zoo's can propagate species threatened with extinction in the wild, sometimes enabling the repopulation of these species. Server like stock varieties that are not commercially popular but are culturally significant or are needed for research and breeding programmes. More recently a number of zoological gardens have been developed as breeding centers for animal species which are in danger of becoming extinct. Many of these species have been saved by breeding in captivity. For example, in 1947, it was estimated that there were only 50 nests left in Hawaii and nowhere else in the world.

3. Tissue culture: Tissue culture technique is another scientific method to conserve plants. This technique has been developed recently and with the help of this technique, from a single cell we can get a complete plant. Each cell in a plant is able to grow is the main principle underlying some reasons like lack of pollinators, sterility or reproductive

organs etc it can be made to grow through tissue culture. Preservation of gene, reproductive materials like seed, semen, etc also helps in conservation.

4. Gene banks: A gene bank is an institution where valuable plant and animal materials likely to be lost in the wild or in cultivation is preserved in a viable condition.

5. Cryo-preservation: It may be defined as the conservation of seeds, pollen etc at freezing temperature or at ultra low temperature. By this method we can preserve pollen and seeds of a plant which are the most essential material for the progeny. The conservation of sperms through Cryo-preservation is also done, not only sperms, but animal cells, ovarian and embryonic tissue and also the whole embryo is also used for livestock breeding programmes.

Micro-organisms which are an important component of any ecosystem have received hardly any attention, particularly their association with the higher plants. These Micro-organisms constitute an important element in the establishment and this aspect needs to be looked into with holistic approach. A wide range of microbes, algae, insects and many other organisms are to be stored for any possible future use.

CREDIT IV: ENVIRONMENTAL ISSUES, POLICIES AND PRACTICES

4.1. CAUSES, EFFECTS AND CONTROL MEASURES OF AIR, WATER, SOIL, NOISE AND SOLID WASTE POLLUTION

ENVIRONMENTAL POLLUTION

Pollution is an undesirable change in the physical, chemical or biological characteristics of air, water and soil that may harmfully affect the human life. The undesirable change is brought by solid, liquid or gaseous substances present in such concentration as may be or tend to be injurious to the environment. Pollutants are often the residues of materials we make rise or throw away e.g. smoke from industries and automobiles, sewage from homes and hotels, radioactive substances from nuclear plants, discarded households articles.

AIR POLLUTION

The presence of certain substances in air beyond those concentration levels that can lead adverse effects on biotic as well as abiotic environmental factors is termed as air pollution.

SOURCES OF AIR POLLUTION

POINT OR STATIONARY SOURCE: It includes fossil fuels, industries, etc.

LINE OR MOBILE SOURCES: It includes those sources which do not cause pollution at a specific point but are moving sources. These include automobiles as the major sources.
AREA SOURCES: It includes those sources of pollution which are prevalent in certain specific area e.g., natural sources like volcanic eruptions, pollen grains; mining activities etc.

TYPES OF AIR POLLUTANTS

Gaseous pollutants: Which include carbon dioxide, carbon monoxide, oxides of sulphur, oxides of nitrogen, hydrogen fluoride, photochemical oxidants, ozone etc.

Particulate pollutants: Particulate is solid or liquid particles which remain suspended in air for prolonged periods. They include metallic dust released from various metallurgical processes; soot from mining and un-burnt fuel particles etc., these particulates can be coal dust, fly ash; sprayed fumes of pesticides; metal dust of lead, chromium, zinc, mercury etc., cotton dust and various forms of chemicals aerosols
Radioactive pollutants The harmful radiations emitted from radioactive substances cause air pollution. Expulsion of nuclear substances and wastes of nuclear power plants also release greater radiations, harmful for living organisms**.**

EFFECTS OF AIR POLLUTION

1. Increased higher concentration of green house gases in air (e.g. CO_2, CH_4, NO_2, SO_2, CFC's, water vapour etc) have caused increase in average global temperature (Global warming) which can lead to serious consequences.

2. Depletion of ozone layer by CFC's is yet another serious effect of air pollution. It was led to increased inflow of ultraviolet radiations reaching the earth's surface which can lead serious health hazards in humans and animals. Constant exposure can damage the vegetation as well.

3. Acid rain is another consequence of air pollution. Gases like oxides of carbon; Sulphur, nitrogen etc combine with water and fall down as acid rain which causes damage to flora, fauna and abiotic structural assets like historical monuments etc. The effects are more pronounced in aquatic systems.

4. Carbon monoxide proves to be fetal even in small concentrations as it blocks hemoglobin for binding of oxygen and reduces the oxygen carrying capacity of blood.

5. Increased ozone concentration in air can lead to pulmonary edema. It along with aldehydes irritates eyes and respiratory organs. Air pollution leads to many respiratory diseases including bronchitis and asthma due to the presence of particulate and irritating gasses.

6. Lead and other metallic particulates have adverse effects on various physiological and biochemical processes of organisms. Fluorides cause fluorosis in animals.

7. Crops are adversely affected by increased concentrations of oxides of sulphur, nitrogen, ozone etc.

8. Air pollution adversely affects the climate in terms of rain fall, humidity and temperature fluctuations.

CONTROL OF AIR POLLUTION

1. Intensive plantation around the settlements reduces the amounts of particulates like dist etc in the air. The trees having simple leaves have been proven much effective. Social forestry and community forestry programmes prove to be effective in controlling air pollution.

2. Installation of industrial units away from human habitations so as to minimize immediate effects of these gases. Besides these, gases get diluted before reaching the people.

3. Shifting to public transport facilities rather than personal conveniences to minimize the release of automobile exhaust.

4. Using much efficient machinery in industry and automobiles to ensure proper and complete combustion of fuels.

5. Using absorbers, adsorbers for unwanted chemicals at the source and along the paths of diffusion of pollutants.

6. Enactment of environment laws.

7. Creating public awareness through debates, discussion, seminars, symposia, etc about the hazards of air pollution.

WATER POLLUTION

The undesirable changes in the natural characteristics of water lead to water pollution.

SOURCES OF WATER POLLUTION

POINT SOURCES: In which almost definite, constant and fixed composition of effluents are discharged directly into a water body like industrial discharge and sewage etc.
NON POINT OR DIFFUSED: In which the effluents are added at different positions with varied composition and volume. These are generally dispersed and diverse in nature e.g. agricultural and domestic run off etc.

EFFECTS OF WATER POLLUTION

1. Water polluted with domestic sewage can spread such epidemic diseases as cholera, typhoid, dysentery or diarrhea and a number of minor ailments and water borne diseases.

2. Heavy influx of nutrients like nitrates and phosphates from adjoining areas increases growth of weeds in aquatic bodies there by leads to process of eutrophication.

3. The use of nitrates in fertilizers enters the drinking water and cause health hazards. Nitrates are converted to nitrites by bacteria when they enter intestine. The nitrites join the blood stream. Hemoglobin has stronger affinity for nitrites than oxygen and therefore, infants suffer from acute lack of oxygen. This disease is known as methaemoglobinema (Blue-baby disease).

4.Influx of methyl mercury into aquatic ecosystem was responsible for infamous disease called Minamata epidemic. Problems like loss of hearing, speech, sight and many deaths were reported during this epidemic.

5. Insecticides and herbicides are very harmful. These destroy a number of valuable aquatic food organisms by destroying the larval stages. By the food chain process the phytoplankton arc seen in the body of carnivores in high concentration and produce fatal effects so that large numbers of fishes are found dead in areas polluted with DDT. The bird population also reduces. In Man DDT enters by eating the carnivores and may cause cancer, nervous disorders and leukemia and other serious ailments.

CONTROL OF WATER POLLUTION

1. Various legislative methods should be employed to control water pollution.

2. Strict check should be maintained on the quality of drinking water. Improved methods for handling and disposal of sewage, garbage and night soil should be introduced.

3. To control the epidemics and other disease, proper methods of sterilization of water drawn from shallow wells, should be developed. The city waste and sewage needs proper treatment.

4. The World Health Organization (W.H.O.) has proposed International Standards for drinking water. These standards must be followed in letter and spirit.

5. Various methods are introduced in controlling water pollution like the methods as adsorption, electro dialysis, ion exchange and reverse osmosis.

6. There are many choices on the personal and social levels that we must make consciously in our town or country.

SOIL POLLUTION

Alteration in soil causing reduced productivity is called soil pollution. Since soil supports plant life which in turn supports animal life, hence soil pollution affects all organisms.

CAUSES OF SOIL POLLUTION

Wind and Water Erosion

Out of 69 mha (million hectare) estimated to be degraded in India, approximately 43 mha are non-arable and barren including 4 mha of ravine lands. The Himalayan Mountains with weak geological formation and poor physiographic conditions are under great stress and suffer from serious water erosion, though water erosion is also rampant in the hills of Western Ghats and areas of high intensity rainfall. Water erosion not only removes the productive surface layer of soil, but also reduces the storage capacity of reservoirs. Wind erosion is more prominent in the hot arid region occupying 31.7 mha of which 61 per cent is found in western Rajasthan. Removals of vegetative cover and over grazing enhance the intensity and extent of wind erosion and desertification.

Water logging

Water logging caused by rise in water table poses a great threat to silt productivity and environmental ecology, especially in the irrigated areas. Roughly an area of 100,000 ha is estimated to be affected by water logging annually. Introduction of canal irrigation is the major reason.

Salinisation and alkalinisation

Continuous use of poor quality groundwater for irrigation leads to the development of soil salinity or sodicity, particularly in the slow permeable solid. It is more serious in the Indo-Gangetic plain, black soil region, arid areas of Rajasthan and coastal Gujarat.

Nutrient loss

In India the nutrient loss is of 5.37 to 8.40 million tones course through erosion every year. The transformation from high internal input agriculture in the past to present day high external input (fertilizers, pesticides) agriculture causes this problem.

Chemical

The industrial wastes contain the colloidal material like clay, Fe_2O_3; Al_2O_3 and MgO_2 etc; dissolved cations like Na^+, K^+, Ca^{++}, Mg^{++}, Mn_2^+, CO and Fe; Dissolved anions like CO_3^{2-}; HCO^{3-}; OH^- ; Cl^-; SO_4^{2-}, HSO_3 etc., organic compounds both bio-degradable and non-biodegradable wastes. The urban and domestic wastes contain mostly the non-degradable wastes like paper, etc.

Pesticides and insecticides

Among pesticides the most important are the chlorinated hydrocarbons e.g. DDT, BHC, aldrin, dieldrain, lindane, chlordane, organo-phosphates include malathion, parathion etc.

Fertilizers These are chemical manures that are added to the soil to increase the crop yield which generally contain one or more of the plant nutrients i.e. nitrogen, phosphorus and potassium.

EFFECTS OF SOIL POLLUTION

1. The industrial pollutants affect and alter the chemical and biological properties of soil.

2. Chemicals and pesticides affect the fertility of soil by killing the soil micro organisms.

3. Pesticides are absorbed by plants and enter to other organisms through food chains and food webs leading to biomagnifications.

4. Application rates of fertilizers are enhanced.

5. Excretory products of human being containing pathogens contaminate soil and vegetable crops.

CONTROL

1. Proper records of land productivity status should be prepared with the help of soil scientists along with the latest technologies like remote sensing.

2. In areas of high water requirement like cropped areas, effective soil and water conservation techniques should be adopted with the guidance of engineers.

3. Industrial activities in the nearby areas, which are hazardous to the environment, should be regulated through laws.

4. Sustainable and effective land use system should be followed.

5. Implementation of agro-forest ecosystem, wherever water erosion is a serious threat.

6. Adoption of integrated water-shed management system and integrated balanced nutrient management system.

7. Auto-regenerating the soil fertility by adding organic matter through micro-organism and incorporation of crop residues should be facilitated.

8. By the use of biofertilizers and manures (which are biological in origin), use of chemical fertilizers can be reduced.

9. By biological control of pests, pesticides can be reduced.

10. Treatment of industrial and municipal sewage can reduce soil pollution, prior to its discharge.

11. Enforcement of environmental regulatory laws.

12. Educating the masses through different media.

NOISE POLLUTION

Noise pollution is defined as unwanted sound that causes discomfort. The release of unwanted sound into the atmosphere is known as noise pollution. Noise intensity is measured in decibel (dB) unit.

SOURCES OF NOISE POLLUTION

1. Industries: Such as printing press, textile mills, engineering works etc.
2. Transport vehicles: Such as trucks, trains, airplanes, buses, cars and other vehicles.
3. Domestic gadgets: It includes noise produces by domestic appliances like TV, radio, washing machines, electric grinders, exhaust fans etc.
4. Defense equipments: Such as tanks, firing practices, rocket launchers etc.
5. Agricultural vehicles: Such as tractors, thrashing and crushing machines etc.
6. Other equipments: Like loud speakers, music systems etc.

EFFECTS OF NOISE POLLUTION

1. Auditory effects.

Auditory effects include both hearing loss and speech interference. The most immediate and acute effect of noise pollution is impairment of hearing. A sudden loud noise can cause severe damage to the ear drum. Long exposure to loud noise can cause hearing loss which may become permanent.

2. Sociological or Psychological effects.

Psychological /sociological effects include an acoustical privacy. Noise pollution increases the rate of heart beat. It causes constriction of blood vessels and cause dilation of the pupils of the ear. Fluctuations in arterial blood pressure, impairment of night vision, are some effects. It causes headache, irritability (annoyance) and extreme emotional disturbances. It aggravates existing disease by disturbing peace of mind and sleep.

CONTROL OF NOISE POLLUTION

The noise pollution can be controlled by the following ways:
1. Technically/modifying and fabricating the machines and using the quieter machines to replace the noisy ones.
2. Regular replace of machinery can reduce noise because much of this noise may be due to inefficiency of the machinery.
3. Construction of walls in the highly noisy polluted area can reduce noise in that area.
4. Restricting the use of public address systems.
5. Growing plants can absorb and dissipate sound energy and thus act as a buffer zone.
6. Noise produced by vehicles can be reduced by banning pressure horns and strictly following the traffic laws.
7. Use of silencers, improvement in design and better installation of machinery in industries can minimize the noise.
8. Each industrial establishment must have such facilities in order to have a check on the intensity of noise pollution, being produced throughout the working period.
9. Industrial areas should be planned in such a way that these should be away from residential areas.

SOLID WASTES

It refers to non-liquid waste materials arising from domestic, trade, Industrial, agriculture, and other activities. The solid wastes include the materials; food wastes, paper, metals, plastics, ceramics, worn-out

clothes, garden wastes, agriculture wastes, Building wastes, hazardous wastes, dust from mining, hospital wastes including discarded cotton, bottles etc; broken utensils ashes from fires, and a variety of other wastes.

CAUSES OF URBAN AND INDUSTRIAL WASTES

1) Rapid growth of *Homo sapiens*

2) Urbanization

3) Changing life styles

4) Industrialization

EFFECTS OF WASTES

1. Health: For the general public, the main risks to health are indirect and these arise from the breeding of disease vectors primarily files and rats. The most serious is the transfer of pollution to water, air and soil. Industries are also introducing danger of different kinds like hazardous wastes during transport and disposal, entry of heavy metals in the food chain etc.

2. Environment: The environmental damage caused by solid wastes mostly pertains to aesthetics. Also, there is the danger of water pollution when the refuse dump enters the water resources. In addition, uncontrolled burning of open dumps can cause air pollution. Water will pollute air and land filling may leach the water and pollute ground water.

CONTROL OF WASTES:

1. Utilization of wastes for generating electricity and biomass.

2. Recycling of the waste.

3. Composting for the generation of organic material and it use as soil conditioner.

4. Land fill disposal

5. Re-organization of the man-power.

6. Incineration

7. Hydro pulping and

8. Pyrolysis.

9. Re-use of waste materials

4.2. CONCEPT OF NATURAL DISASTERS AND ENVIRONMENTAL ISSUES

Concept/definition: A disaster is an event of nature or human that leads to sudden disruption of normal life of society, causing damage to life and property, to such an extent that normal social and economic mechanisms available are inadequate to restore with a high frequency of natural causes like droughts, floods, cyclones and earthquakes and occasional tragedies like the gas lead at Bhopal.

1. Natural: Water and Climate related Disasters: Floods, cyclone, Tornadoes, hurricanes, Hailstorm, Cloud burst, Heat and cold wave, Snow avalanches, Droughts, sea erosion and thunder and lightning. Geology related disasters: Landslides and mudflows, Earthquakes, mine fires, Dam failures /bursts.
2. Manmade: Chemical disasters, nuclear disasters. Accident related disasters: Forest fires, urban fires, Mine flooding, Oil spills, building collapse, Bomb blasts, festival related disasters, Electrical disasters and fires, Air, road and rail accidents, Boat capsizing, Village fire etc.

GLOBAL WARMING

Global warming may be defined as increase in average mean global temperature due to increase in the concentration of green house gases like carbon dioxide, ozone, methane, nitrous oxide etc.

GREEN HOUSE GASES

Green houses gases occur naturally in the environment and also result from human activities. By far the most abundant green house gas is water vapor, which reaches the atmosphere through evapo-transpiration from water bodies and vegetation. Carbon dioxide is the next abundant green house gas. It flows in to the atmosphere from many natural processes, such as volcanic eruptions; the respiration of animals, and the burning and decay of organic matter, such as plants.

Due to burning of fossil fuels, solid wastes and wood and wood products is the consequence of human activities which resulted in carbon dioxide release into the atmosphere at much faster rates than earth's natural processes can cycle this gas. One hundred years ago, there were about 281 parts per million of carbon dioxide in the atmosphere. Today there are 394 parts per million, which reflects a 30 percent increase. The carbon dioxide concentration increases by about 1.8 parts per million per year. If current predictions prove accurate, by the years 2100 carbon dioxide will reach more than 500 parts per million. Methane is an even more effective insulator trapping over 21 times more heat than does the same amount of carbon dioxide. Methane is emitted during the production and transport of coal, natural gas, and oil. Methane also comes from decomposing organic waste in landfills, and it is released from certain animals, especially cows, as a byproduct of digestion. Nitrous oxide is a powerful insulating gas released chiefly by burning fossil fuels and plowing farm soils. Nitrous oxide traps over 270 times more heat than does the same amount of carbon dioxide. The concentration of nitrous oxide in the atmosphere has increased 15 percent over pre-industrial levels

GREEN HOUSE EFFECT

The warming of the globe as is believed to be due to release of Green House Gases in the atmosphere is called Green House Effect. The energy that lights and warms Earth comes from the Sun. Most of the energy that floods onto our planet is short-wave radiation including both visible and ultraviolet. When this energy strikes the surface of Earth, the energy changes from light to heat and warms Earth. The earth's Surface in turn, releases some of this heat especially at night, as long-wave infrared radiation. Much of this long-wave infrared radiation makes it all the way back out to space, but a portion remains trapped in Earth's atmosphere. Certain gases in the atmosphere, including water vapour, carbon dioxide, and methane, provide the trap. Absorbing and reflecting infrared waves radiated by Earth, these gases conserve heat as the glass in a green-house does and are thus known as greenhouse gases. As the concentration of these greenhouse gases in the atmosphere increases, more solar energy remains trapped below. All life on Earth relies on this greenhouse effect. Without it, the planet would be colder by about 33 Celsius degrees (59 Fahrenheit), and ice would cover Earth from pole to pole. However, a growing excess of green house gases in Earth's atmosphere threatens to tilt the balance in the other direction towards continual warming.

CLIMATE CHANGE

When any major change occurs in temperature, precipitation, wind patterns and it extends for longer periods of time (decades) is called as climate change.

CAUSES OF CLIMATE CHANGE

Over the last several years' extensive growth in population, rapid industrialization, excessive use of fossil fuels, deforestation, increase in automobiles and jet-aero planes caused a drastic change in climate. Due to the natural and anthropogenic activities like soil erosion, flood, landslides, volcanic eruption, earthquake, drought, forest fire, population growth, over-grazing, transportation, urbanization, consumerism etc. several problems arise which are harmful to both humans and nature. These activities release greenhouse gases like Co_2, CH_4, N_2O, and CFC's etc. in the atmosphere and cause increase in the average global temperature. The implications of greenhouse are serious. The Inter-Governmental Panel on Climate Change (IPCC) has predicted that this rise of one degree will happen by the year 2025.

EFFECTS

1. Climate change and forests

3. Climate change and water resources

4. Climate change and tourism

5. Sea level rise

6. Global temperature rise

7. Erratic precipitation

8. Extreme events

9. Ocean acidification

ACID RAIN

The rain water that contains dangerous chemicals because of smoke from cars and factories. The word has been first used in 1845. The examples are trees damaged by acid rain.

It can be described as the presence of excessive acids in rain waters. Un-polluted rain is naturally acidic because carbon dioxide from atmosphere combines with water to a sufficient extent to form carbon acid (weak). The pH for pure rain water is in the range of 5.6 – 6.5. In some cases a low record of pH 3.0 has also been recorded. The pH is not altered only by CO_2 but ever oxides of Sulphur, nitrogen are known to change pH towards the acidic state. In the absence of the human activity the concentration of SO_2 in the atmosphere ranges from 1-3 $\mu g/m^3$. This is a result of H_2S produced by organisms in nature. The H_2S in oxidized to SO_2 by O_3 in the atmosphere.

A small contribution of SO_2 is given by Sulphur springs and a substantial quantity by volcanic activities. The acid rain problem for the first time came to the attention in Northern Europe in 1958 when Sweden and Norway lakes were found to be losing their fish populations and some lakes contained no fish at all. After a thorough survey and investigation, the pH between 2.2 to 2.3. India, Japan, UK and other countries also found increasing acidity in natural waters and soils due to acid rain. In India the Taj Mahal and other stoney and historical monuments and buildings are under threat from acid rains. The other historical monuments which are being attacked by acid precipitation are Jamia Masjid, Red Fort and Qutab Minar in Delhi and Gol Gumbaz in Bayapur. As these historical buildings are made up of marble stone, they are degraded by acids.

The anthropogenic pollution of the atmosphere with SO2 started with the use of metals of Sulphur compounds. The polluted areas in the beginning were small but now they are extended to terrestrial and aquatic ecosystem of large parts of earth's surface. The amount of SO2 is rapidly increasing with an increase in industrialization, urbanization etc. The most important produces of Sulphur emission are coal burning power plants, industrial boilers and smelters, etc. when the SO2 gets absorbed in suspended particulate matter in the air such as dust, fly ash etc and comes in contact with moisture droplets, it turns into sulphuric acid. Not only oxides of Sulphur but even oxides of nitrogen are also known to create acidic rains. Nitrogen dioxide gas from motor vehicle exhaust is converted into nitric acid. Unless, they are neutralized in reaction with alkaline compounds in the atmosphere, these strong acids eventually return to the earth as acid rain.

STRATOSPHERIC OZONE LAYER DEPLETION

A layer of ozone in the upper atmosphere that prevents dangerous radiation from the sun from reaching the surface of the Earth is called as stratospheric ozone. An atmospheric layer at heights of about 20 to 30 miles (32 to 48 kilometers) that is normally characterized by high ozone content which blocks most solar ultraviolet radiation from entry into the lower atmosphere. The concentration of ozone in stratosphere occurs up to 10ppm. The formation of ozone by the action of sunlight on oxygen in this action has been taking place for many millions of years, but naturally occurring nitrogen compounds in the atmosphere apparently have kept the ozone concentration at a fairly stable level. The presence of this ozone up in the stratosphere absorbs some of the potential harmful ultraviolet (UV) radiation from sun (at wavelength between 240 and 320) which otherwise can cause skin cancer and damage vegetation among other things. Although ozone at ground level is a health hazard causing respiratory ailments such as bronchitis and asthma. It also damages vegetation and causes rubber and some plastics to deteriorate. Nitrogen oxides and volatile organic gases emitted by automobiles and industrial sources combine to form ozone.

The loss of ozone (Greek, ozein "to smell"), a pale blue, highly poisonous gas with a strong odour was not known till two American scientists discovered the capabilities of chlorine atom released from chlorofluorocarbons(CFC's) of eating ozone. The ozone which is present in the stratosphere is continuously being produced and destroyed. The production takes place when molecular oxygen is split by UV-solar radiation and the resulting oxygen atom (O) attach themselves to other oxygen molecules.

Sometimes these reactions are also known as "Chapman reaction". The layer of ozone formed in the stratosphere by these reactions is sometimes called the "Chapman layer". However, this theory has its limitations that in the reaction the loss of ozone given was too slow. It could not remove enough ozone to give the values seen in the real atmosphere. There had to be other reactions, faster reactions that were controlling the ozone concentration in the stratosphere.

OZONE LAYER DEPLETION

Loss of ozone in the lower stratosphere over Antarctica was first noticed in the 1970's. In 1985, the drop in ozone levels in the Stratosphere showed that the loss was rapid and of large scale over most of the Antarctica continent. There are also many new measurements and observations of the changes in ozone that occur over Antarctica. There has been a phenomenal decrease from 1975 onwards in the total ozone and it was recorded less than half its value during the year 1994. This dramatic fall in ozone was caused by the use of manmade chemicals known as halocarbons which include the well known CFC's commonly used in fridges and so on. These CFC's had made their way into the upper atmosphere where the much stronger UV radiation from the sun had broken them down into their component molecules, releasing the potentially damaging chlorine(and bromine) atoms, which could destroy ozone. The loss of ozone was not restricted to Antarctic only but there had been an ozone decrease over the heavily populated northern mid-latitudes (30-60N). However, unlike the sudden and near total loss of ozone in mid-latitudes is much less and much slower only a few percentage per year.

4.3. ENVIRONMENTAL LAWS

Environment protection and its preservation is today the concern of all. Today the interaction between nature and the society is so extensive that environmental question has assumed all proportions affecting all humanity. The destruction and pollution has threatened the human life, health and livelihood. We are facing with poverty, hunger, ill-health, illiteracy and the continuous deterioration of the ecosystems on which we depend. With the result there has been thrust on the protection of environment not only in our country but throughout the world. If the quality of the life is to be assured to the present and the future generations and to be saved from the catastrophe, the environment has to be protected. It is a basic right of all to live in a healthy environment. Besides our country needs development and that too fast. But that can't be done at the cost of our environment. We can't endanger our life as well as the life of future generations. We have to think sustainably. Today we need **Development, Environment and Peace** which are interdependent and indivisible. The present century particularly the later half has seen a lot of growth and economic development. The methods of economic development which mankind has followed have created environmental problems. The industrialization, urbanization and erosion of biodiversity have affected the natural environment adversely.

The judicial response to almost all environmental litigations has been very positive in India. The primary effort of the court while dealing with the environment related issues is that enforcement agencies take effective steps for the enforcement of the laws. The judicial development of environmental law has been vigorous. There are environmental courts to deal with environmental matters. The aim is to provide decent standard of life to all which can be possible only in a **"pollution free environment."** The problem of environment is tackled through various statutes. The legislative powers are shared between central and the state governments. There are ample provisions to make laws dealing with environmental problems at the local and national levels.

In view of the article 253 of the union list, the parliament of India has made use of this power to enact the Air (Prevention and Control of Pollution) Act of 1981 and the Environment (Protection) Act of 1986.

The Indian parliament drew immense inspiration from the proclamation adopted by the United Nations Conference on the Human Environment which took place at Stockholm, 1972 and enacted the Water (Prevention and Control of Pollution) Act of 1974.

4.3.1. THE WATER (PREVENTION AND CONTROL OF POLLUTION) ACT, 1974

This is an Act which is meant for the prevention and control of pollution in the environment and for the matters which are connected with the abatement of pollution. The Act was enacted by the Indian Parliament in the 25th year. This Act may be called The Water (Prevention and Control of Pollution) Act, 1974. It shall come into force as may be notified in the Official Gazette and it extends to whole of India.

OBJECTIVES

1. To provide for the prevention and control of water pollution and the maintaining or restoring of wholesomeness of water.

2. To establish Central and State Boards for the prevention and control of water pollution.

3. To provide for conferring on and assigning to such Boards powers and functions relating thereto and for matters connected therewith.

4. To provide penalties for the contravention of the provisions of the Water Act.

5. To establish Central and State water testing laboratories to enable the Board to assess the extent of pollution, lay down standards and establish guilt or default.

4.3.2. THE AIR (PREVENTION AND CONTROL OF POLLUTION) ACT, 1981

This is an Act which is meant for the prevention and control of pollution in the environment and for the matters which are connected with the abatement of pollution. The Act was enacted by the Indian Parliament in the 32nd year. This Act may be called The Air (Prevention and Control of Pollution) Act, 1981. It shall come into force as may be notified in the Official Gazette and it extends to whole of India.

OBJECTIVES

1. To provide for the prevention and control of air pollution and the maintaining or restoring of wholesomeness of air quality.

2. To establish Central and State Boards for the prevention and control of air pollution.

3. To provide for conferring on and assigning to such Boards powers and functions relating thereto and for matters connected therewith.

4. To provide penalties for the contravention of the provisions of the Water Act.

5. To establish Central and State air testing laboratories to enable the Board to assess the extent of pollution.

6. To lay down the standards to maintain the quality of the air and establish guilt or default.

4.3.3. THE ENVIRONMENT (PROTECTION) ACT, 1986

This is an Act which is meant for the protection and improvement of environment and for the matters which are connected with the abatement of pollution. The Act was enacted by the Indian Parliament in the 37th year. This Act may be called The Environment (Protection) Act, 1986. It shall come into force as may be notified in the Official Gazette and it extends to whole of India.

OBJECTIVES

1. To implement the decisions made at the U.N. Conference on the Human Environment held at Stockholm in June, 1992.

2. To enact general law on environmental protection which could cover uncovered gaps in the areas of major environmental hazards as the existing laws generally focused on specific types of pollution or on specific categories of hazards substances and some major areas of environmental hazards were not covered.

3. To co-ordinate activities of the various regulatory agencies under the existing laws and creation of an authority or authorities for environment protection.

4. To provide penalties for the contravention of the provisions of the Act or who endanger human environment, safety and health.

4.4 ENVIRONMENTAL EDUCATION: GOALS, OBJECTIVES AND NEED FOR PUBLIC AWARENESS

Environmental Education (EE) is a process in which individuals gain awareness of their environment and acquire **knowledge, skills, values, experiences** and also the **determination,** which will enable them to act - individually and collectively - to solve present and future environmental problems.

GOALS AND OBJECTIVES

1. Awareness and sensitivity to the environment and environmental challenges.

2. Knowledge and understanding of the environment and environmental challenges.

3. Attitudes of concern for the environment and motivation to improve or maintain environmental quality.

4. Skills to identify and help resolve environmental challenges.

5. Participation in activities that lead to the resolution of environmental challenges.

6. Evaluation abilities i.e. evaluate environmental measures and educational programmes in terms of ecological, aesthetic, economical, social and educational factors.

NEED FOR PUBLIC AWARENESS:

There is a need for environmental awareness and a concern to protect it. One must know the grave dangers that await all life on this planet if due care is not taken towards environmental conservation and protection. Further, the effect of environmental pollution often does not remain confined to one region. For instance, the effect of the increased levels of carbon dioxide in the atmosphere, depletion of ozone, acid rains etc. are a few to mention. At present we are facing with many environmental issues which have grown in size day by day. Still land and natural resources are being exploited without any ethics and the wastes produced are pumped into the environment freely. However, some realisation has started developing that air, water and land have limited carrying capacities and that pollution control measures must be instituted to safeguard the environment and the quality of human life.

ROLE OF MASS MEDIA AND ENVIRONMENTAL ORGANIZATIONS

Environmental awareness is a planned communication process to promote the knowledge of environment, keep people up to date about catastrophic impacts of human development and help them to know about sustainable development.

For the sake of our world, clearly environmental awareness plays a critical role for creating interest in environment. This is the time which demands us to deliver the sensitivity of environmental issues to the masses particularly among youth.

ROLE OF ENVIRONMENTAL ORGANIZATIONS

A non-governmental organization (NGO) is an organization that is neither a part of a government nor a conventional for profit business. Usually set up by ordinary citizens, NGOs may be funded by governments, foundations, schools, businesses, or private people.

Today we come across various non-governmental organizations whose concerns are focused on various areas such as social issues, health issues, and environmental issues. These NGO's are involved in the whole spectrum of developmental activities from creating environmental awareness to undertaking watershed development, from disaster management to sustainable livelihoods, from joint forest management to giving inputs to policies. They range from clubs which encourage nature camping to agencies which undertake research and monitoring. There are large number of NGOs in India and other countries that are exclusively working for environmental protection, conservation and awareness. The number of these non-governmental organizations which are actively involved in environmental protection in our country is, in fact, more than in any of the developing country.

Some of the international environmental organizations are Greenpeace, Worldwide Fund for Nature' (WWF), Earth First, etc.

ENVIRONMENTAL MOVEMENTS IN INDIA:

1. CHIPKO ANDOLAN:

The contribution of common people towards the conservation of forests is the *Chipko Andolan* (Hug the trees movement). The *Chipko Andolan* originated from an incident in a remote village called 'Reni' in Garwal, high up in the northern Himalayas in the early 1970's. The word "chipko" refers "to stick" or "to hug". The

name of the movement comes from a word meaning "embrace": where the villagers hug the trees, saving them by interposing their bodies between them and the contractors' axes. A logging contractor had been allowed to cut down trees in a forest close to a village. The people of the village did not want this forest to be cut down because it would have spoiled their healthy environment. One day, when the men folk of the village were out of work, the contractors workers came in the forest to cut down the trees. In the absence of men, the women of the village reached the forests quickly and clasped the tree trunks with their arms, preventing the workers from cutting down the trees. The forest trees were thus saved. The Chipko movement quickly spread across all the communities and helped in the conservation of forests.

This gave a start to the "Chipko Movement". The main objective of this movement was to ensure an ecological balance and the survival of the tribal people whose economic activities revolved around these forests. Sunderlal Bahuguna, a renowned Gandhian, with a group of volunteers and women started the non-violent protest by clinging to the trees to save them from felling.

2. NARMADA ANDOLAN:

The Narmada Bachao Andolan (NBA) is the peoples, movement that mobilized itself against the development in the mid- and late-1980s. The movement first started as a protest for not providing proper rehabilitation and resettlement for the people who have been displaced by the construction of Sardar Sarovar Dam. Later on, the movement turned its focus on the preservation of environment and the eco-systems of the valley.

The arguments in favor of the construction of the dam say that it is intended to irrigate large tracts of land in Gujarat, provide drinking water to drought- prone villages and towns and generate electricity. The withdrawal of the World Bank from the project was considered to be a major victory for the anti-dam activists.

In October 2000 the Supreme Court gave a judgment approving the construction of the Sardar Sarovar Dam. The court decided that the height of the dam be raised to 90 m. This height is much higher than the 88 m which anti-dam activists demanded, but it is definitely lower than the proposed height of 130 m.

After the Supreme Court judgment, the Gujarat Government has taken up the construction of the dam. As the World Bank withdrew its financing in 1993 the project is now largely financed by the state governments and market borrowings. Now the project is expected to be fully completed by 2025.

3. SILENT VALLEY

An NGO in Kerela namely Save Silent Valley (SSV) was a social movement aimed to protect Silent Valley which is an evergreen tropical forest area in the Palakkad district of Kerela, India. The Kuntipuzha river that flows through Silent Valley was surveyed and identified an ideal site for electric generation by the Kerela State Electricity Board in 1958. In 1973 the Save Silent Valley (SSV) take an initiative to save the Silent Valley Reserve Forest from being flooded by a hydroelectric project. The Kerela Shastra Sahitya Parishad (KSSP) was another NGO working for environmental awareness among masses from many years. It was the only organization in 1978 whose campaign turned out to be a public education programme in many respects. The movement in many ways helped to save the ecosystem of Silent Valley. The valley was declared as Silent Valley National Park in 1985.

ENVIRONMENTAL ETHICS

Ethos, the Greek work from where "ethic" is derived means the character. Environmental ethics can be described as the individual's character to become compatible with the environment. Recognition of

the environment is the need for the survival of human beings. This requires minimum manipulation of environmental components and judicious use of resources treating all of the earth as a sacred land so that its contents are neither diminished nor changed permanently. It is the basic idea of environmental ethics.

BOOKS RECOMMENDED:

1. Bharucha, E, 2005. Text Book of Environmental Studies. Universities Press (India), Hyderabad.

2. Joseph, Benny,2005. Environmental Studies. McGraw Hill Companies.

3. De, Anil Kumar and De, Arnab Kumar, 2nd edition.New Age International Publishers.

4. Kanagasabai,S.2010. Text book on Environmental Studies.PHI Learning.

5. Chauhan,B.S.2008. Environmental Studies.University Science Press

6. Jaiswal,P.S.2007.Environmental Law. Pioneer Publications,Delhi.

7. Ghosh,G.K.1992. Environmental Pollution.Ashish Publication,Delhi